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Yamaguchi

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(54) **APPARATUS FOR SENSING USER CONDITION TO ASSIST HANDWRITTEN ENTRY AND A METHOD THEREFOR**

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G06K 9/20	(2006.01)
G06F 3/01	(2006.01)
G06F 3/033	(2013.01)
G06F 3/042	(2006.01)
G06F 3/0488	(2013.01)

(52) **U.S. Cl.**

CPC ***G06K 9/2081*** (2013.01); ***G06F 3/011*** (2013.01); ***G06F 3/0334*** (2013.01); ***G06F 3/0425*** (2013.01); ***G06F 3/04883*** (2013.01); ***G06K 9/00335*** (2013.01); *G06K 2209/01* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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(57) **ABSTRACT**

In an entry assistance apparatus, when the user makes handwritten entry on a medium, a detector detects person condition information on a condition regarding the body of the user. The person condition information may include either or both of positional information on the position of the user and postural information on the posture of the user. Based on the person condition information, a condition estimator estimates one or more conditions of the user. Based on the condition of the user, a presentation information selector selects presentation information on one or more information contents to be presented to the user. The information content indicated by the presentation information will be presented to the user by an information presenter.

16 Claims, 14 Drawing Sheets

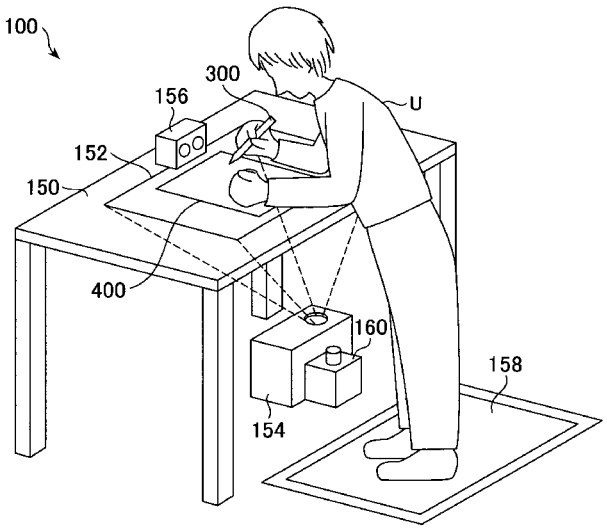


FIG. 1

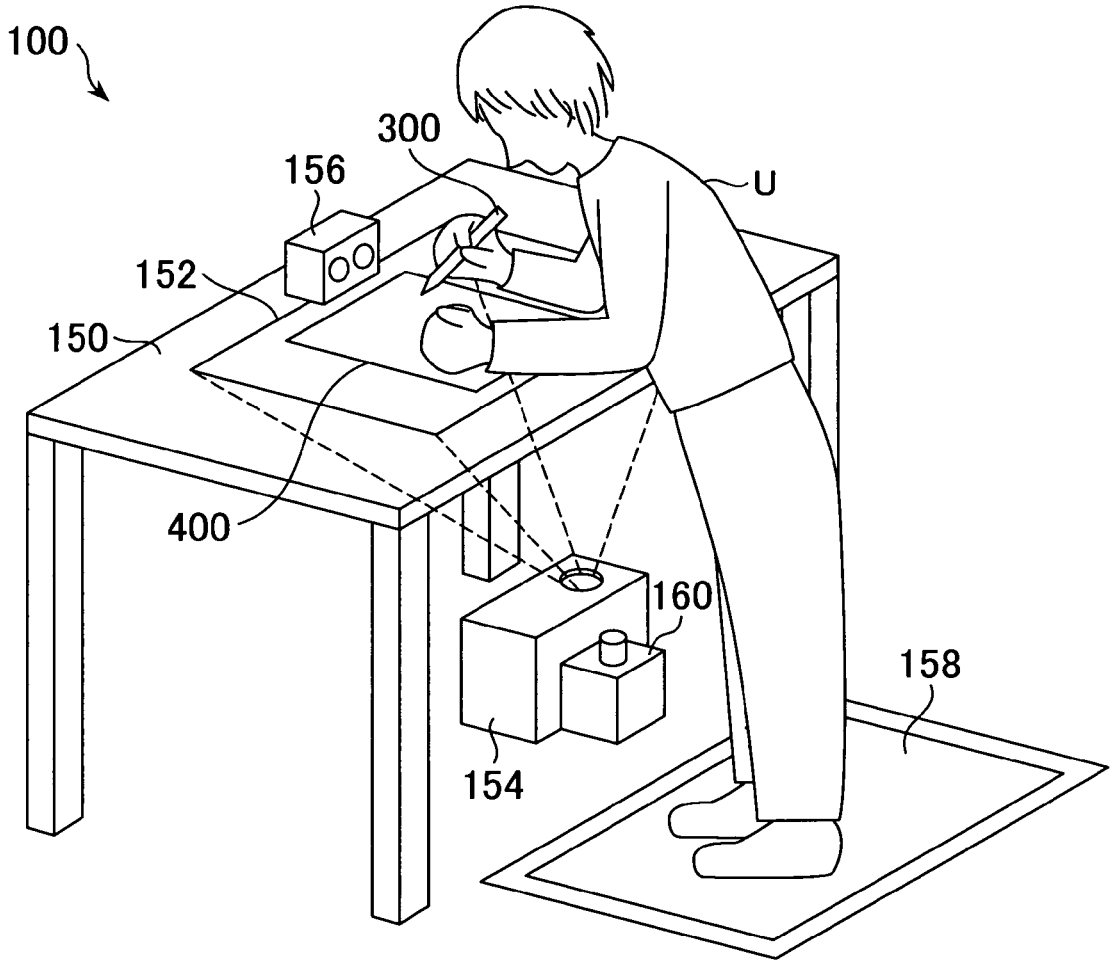


FIG. 2

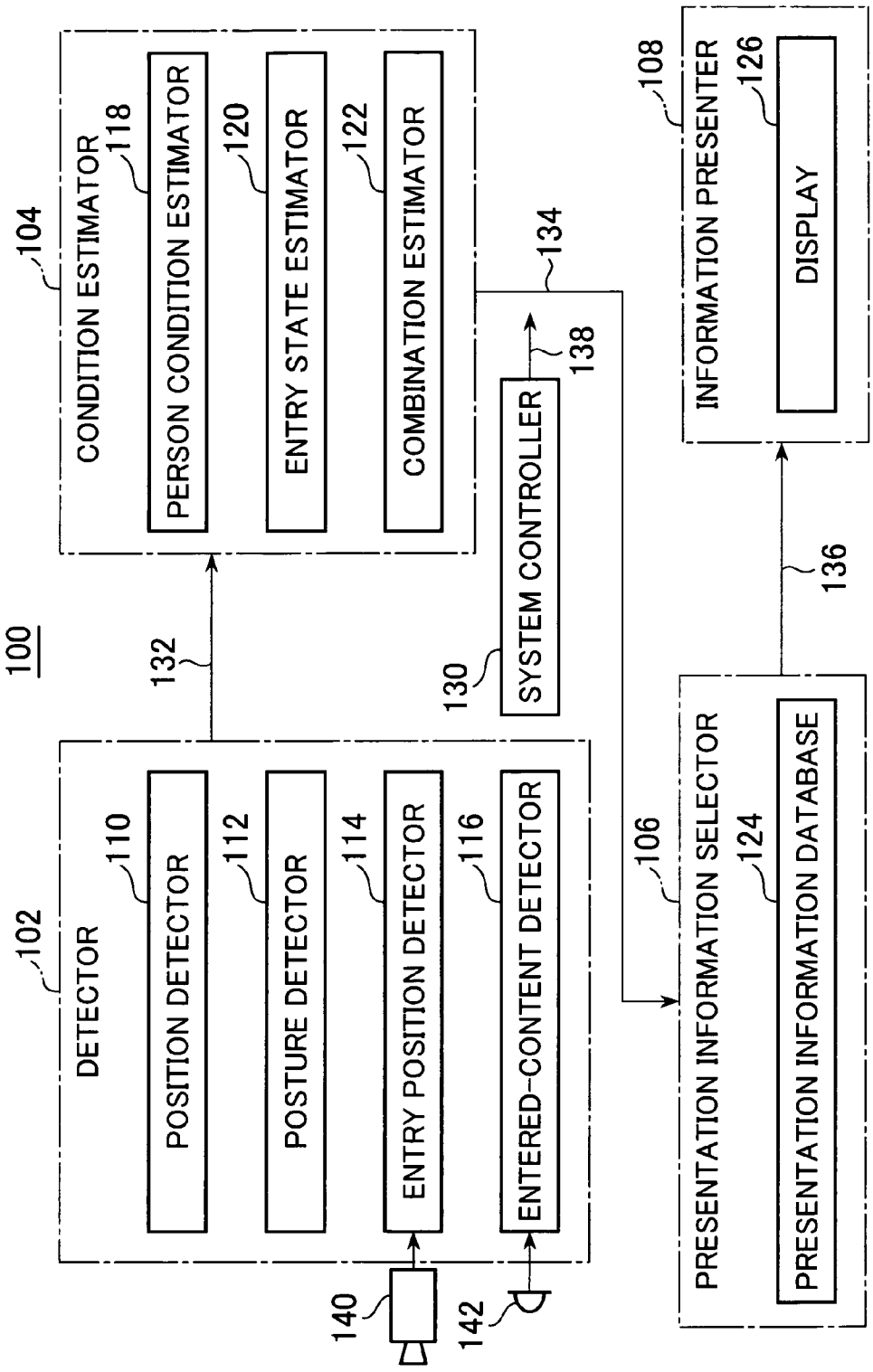

100
102
DETECTOR
110
POSITION DETECTOR
112
POSTURE DETECTOR
114
ENTRY POSITION DETECTOR
116
ENTERED-CONTENT DETECTOR
104
CONDITION ESTIMATOR
118
PERSON CONDITION ESTIMATOR
120
ENTRY STATE ESTIMATOR
122
COMBINATION ESTIMATOR
106
PRESENTATION INFORMATION SELECTOR
124
PRESENTATION INFORMATION DATABASE
108
INFORMATION PRESENTER
126
DISPLAY
130
SYSTEM CONTROLLER
132
134
136
138
140
142

FIG. 3

122

CONDITION 1	CONDITION 2	CONDITION 3	...	ESTIMATED CONDITION
T	F	F	...	ENTRY IS STARTED
T	T	F	...	PUZZLED AS TO WHICH PAPER FORM SHEET SHOULD BE SELECTED
T	F	T	...	PUZZLED AS TO WHICH FORM FIELD ENTRY SHOULD BE MADE
...	...	...	...	...

FIG. 4

124

CONDITION ID	TYPE OF PRESENTATION INFORMATION	FILE NAME	SPECIFIED DISPLAY SECTION	PRIORITY
1	MESSAGE	a001.jpg	(0,200,400,1000)	3
2	ALERTING	a002.jpg	(300,400,600,800)	3
3	MESSAGE	a003.jpg	-	2
...	...	...	...	...

FIG. 5

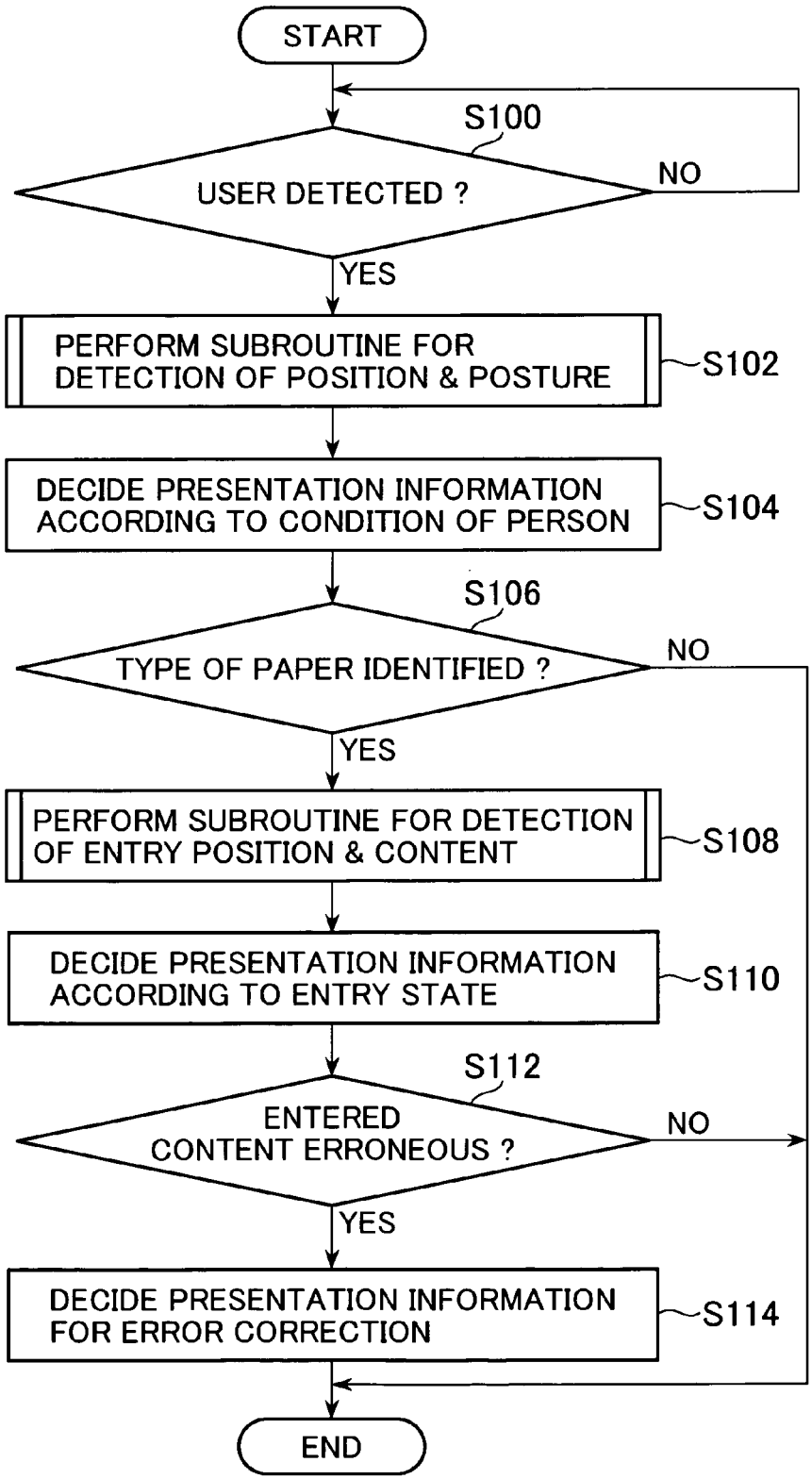

START
S100
USER DETECTED ?
NO
YES
PERFORM SUBROUTINE FOR DETECTION OF POSITION & POSTURE
S102
DECIDE PRESENTATION INFORMATION ACCORDING TO CONDITION OF PERSON
S104
S106
TYPE OF PAPER IDENTIFIED ?
NO
YES
PERFORM SUBROUTINE FOR DETECTION OF ENTRY POSITION & CONTENT
S108
DECIDE PRESENTATION INFORMATION ACCORDING TO ENTRY STATE
S110
S112
ENTERED CONTENT ERRONEOUS ?
NO
YES
DECIDE PRESENTATION INFORMATION FOR ERROR CORRECTION
S114
END

FIG. 6

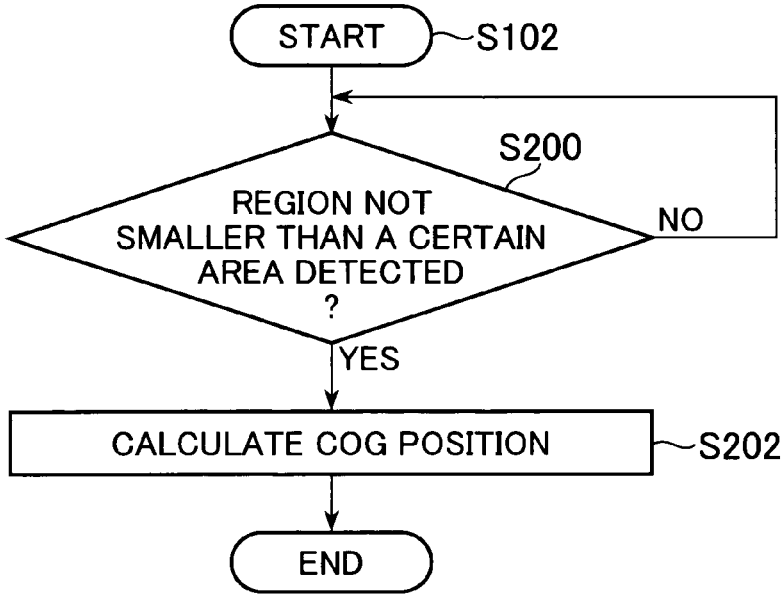

START
S102
S200
REGION NOT SMALLER THAN A CERTAIN AREA DETECTED ?
NO
YES
CALCULATE COG POSITION
S202
END

FIG. 7

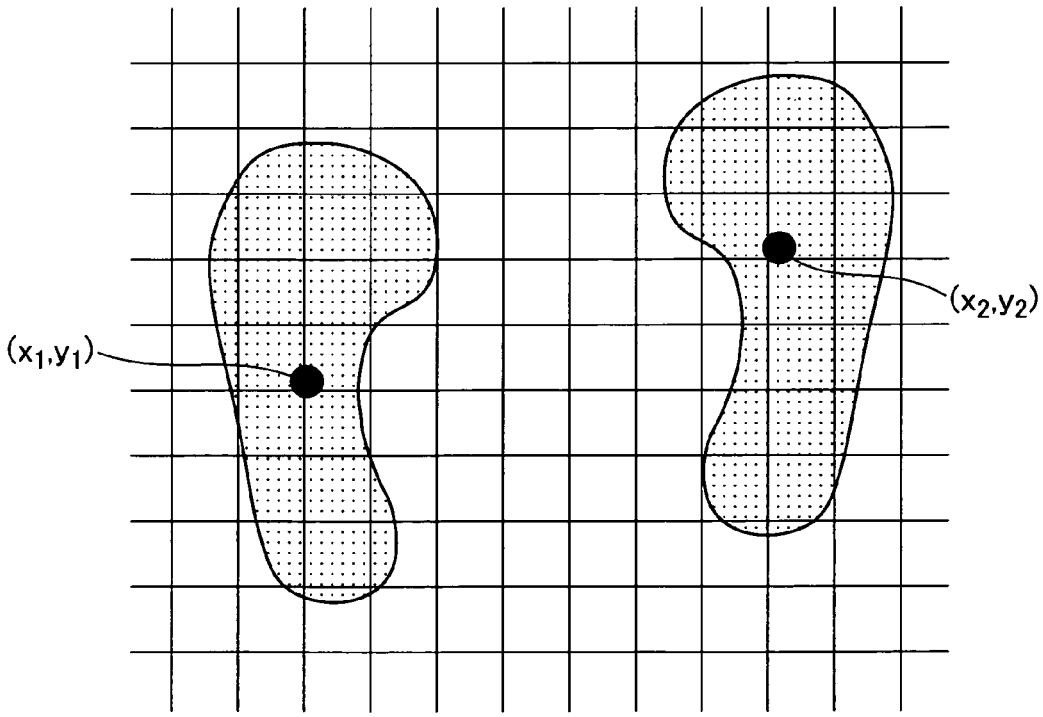

(x_1,y_1)
(x_2,y_2)

FIG. 8

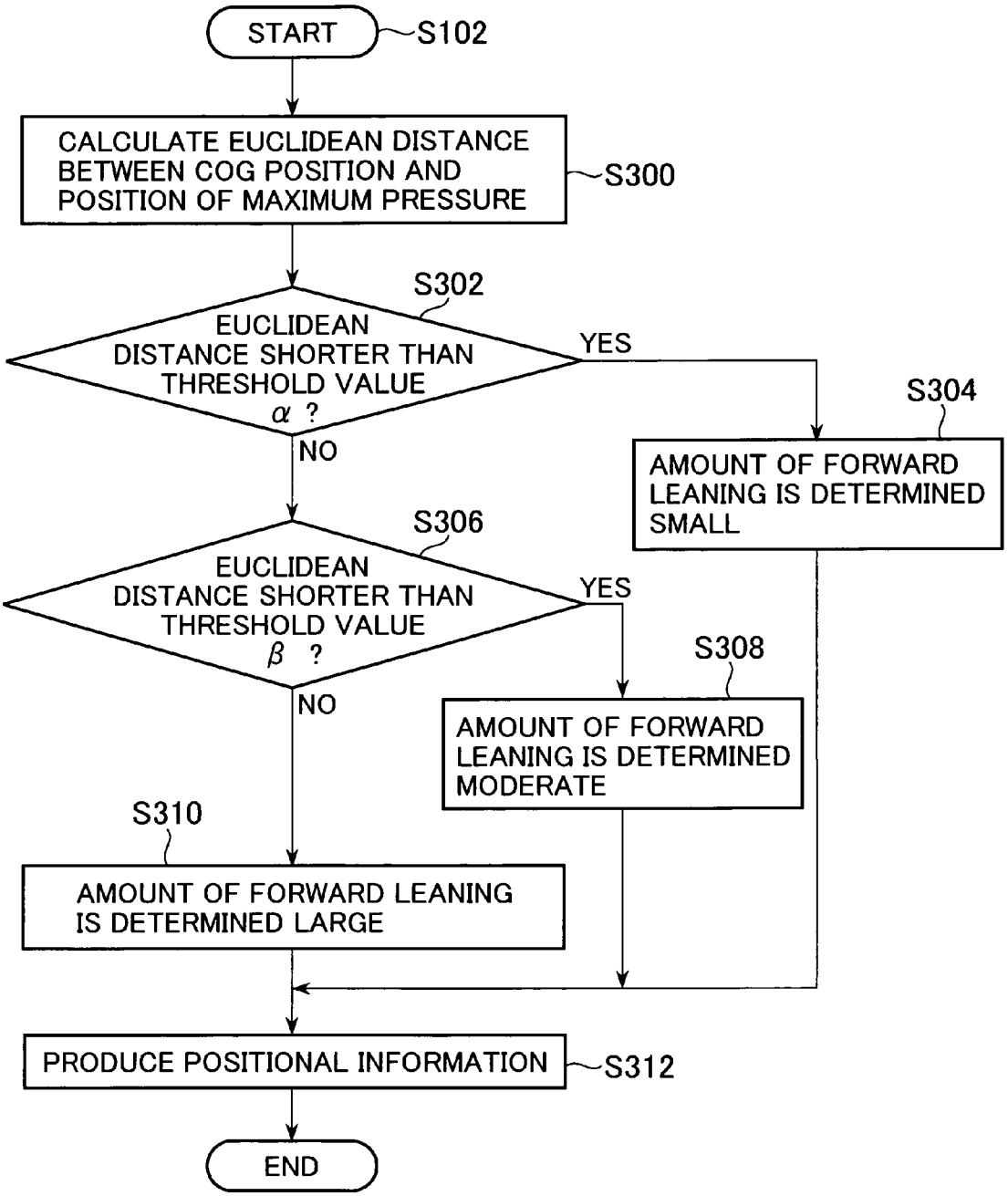

START
S102
CALCULATE EUCLIDEAN DISTANCE BETWEEN COG POSITION AND POSITION OF MAXIMUM PRESSURE
S300
S302
EUCLIDEAN DISTANCE SHORTER THAN THRESHOLD VALUE α ?
YES
NO
S304
AMOUNT OF FORWARD LEANING IS DETERMINED SMALL
S306
EUCLIDEAN DISTANCE SHORTER THAN THRESHOLD VALUE β ?
YES
NO
S308
AMOUNT OF FORWARD LEANING IS DETERMINED MODERATE
S310
AMOUNT OF FORWARD LEANING IS DETERMINED LARGE
PRODUCE POSITIONAL INFORMATION
S312
END

FIG. 9

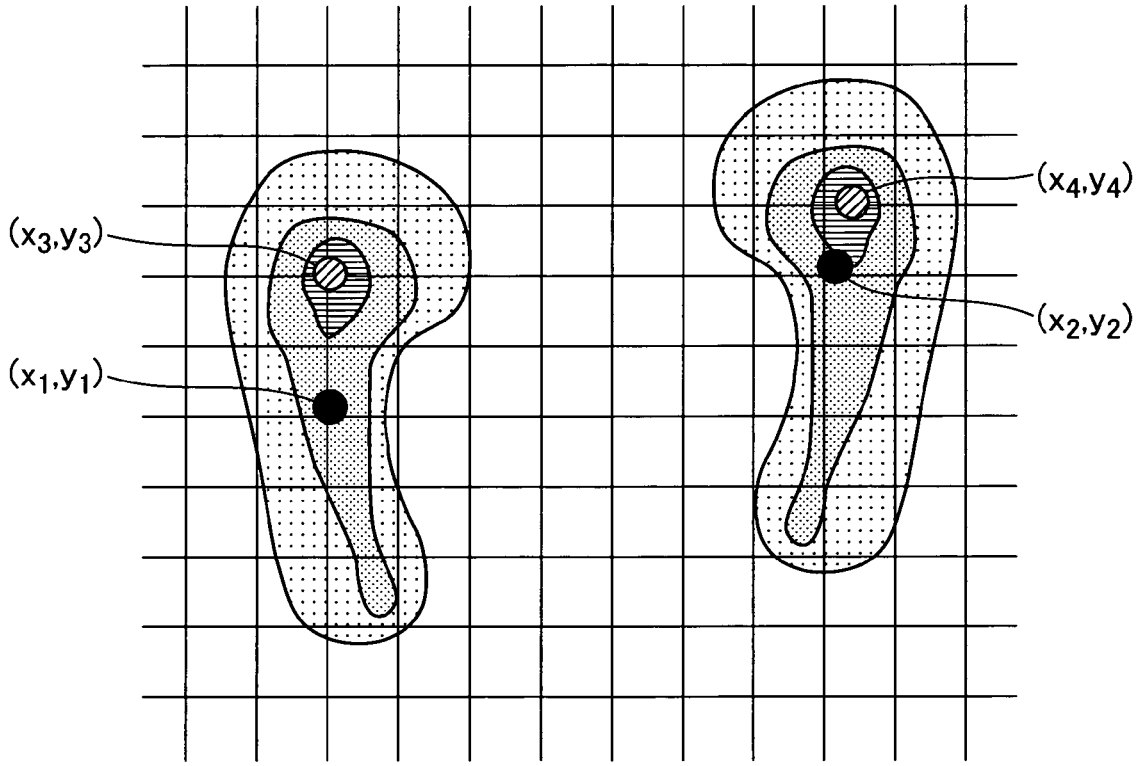


FIG. 10

HEAD POSITION (AMOUNT OF FORWARD LEANING HELD AT LARGE, MIDDLE, OR SMALL)	MOVING SPEED OF HEAD	ACCELERATION IN MOVEMENT OF HEAD	NUMBER OF OBSERVATIONS OF AMOUNT OF FORWARD LEANING EQUAL TO MIDDLE OR MORE	POSTURAL INFORMATION ON PERSON
MIDDLE OR MORE	HIGH OR MORE	LOW OR MORE	0 OR MORE	TILTED QUICKLY
MIDDLE OR MORE	LOW OR MORE	LOW OR MORE	0	TILTED FOR THE FIRST TIME
MIDDLE OR MORE	LOW OR MORE	LOW OR MORE	THRESHOLD VALUE α OR MORE	SLOWLY TILTED PLURAL TIMES
...	...	...	...	...

FIG. 11

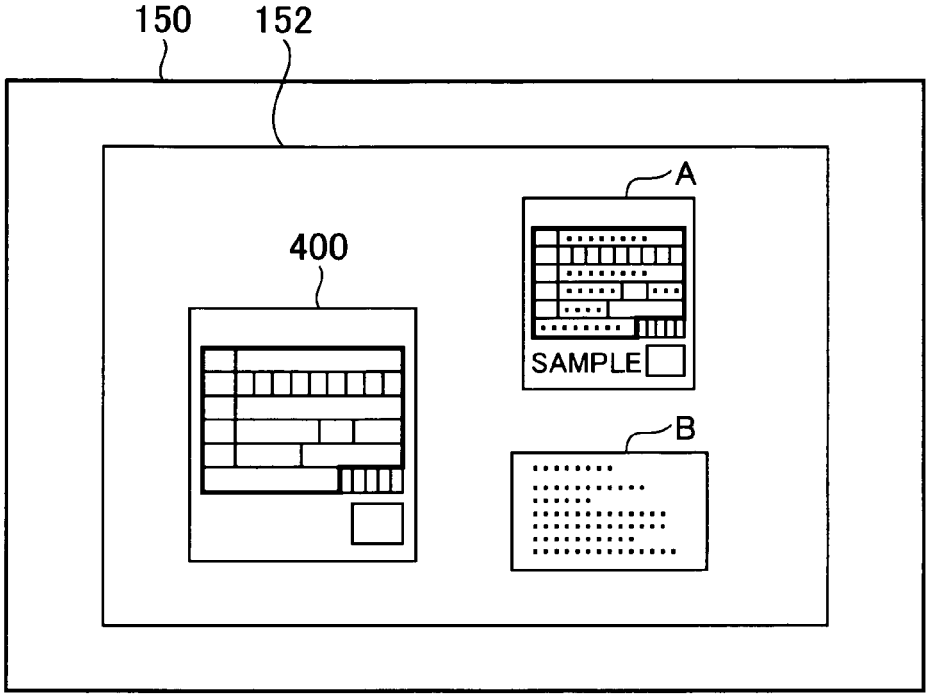


FIG. 12

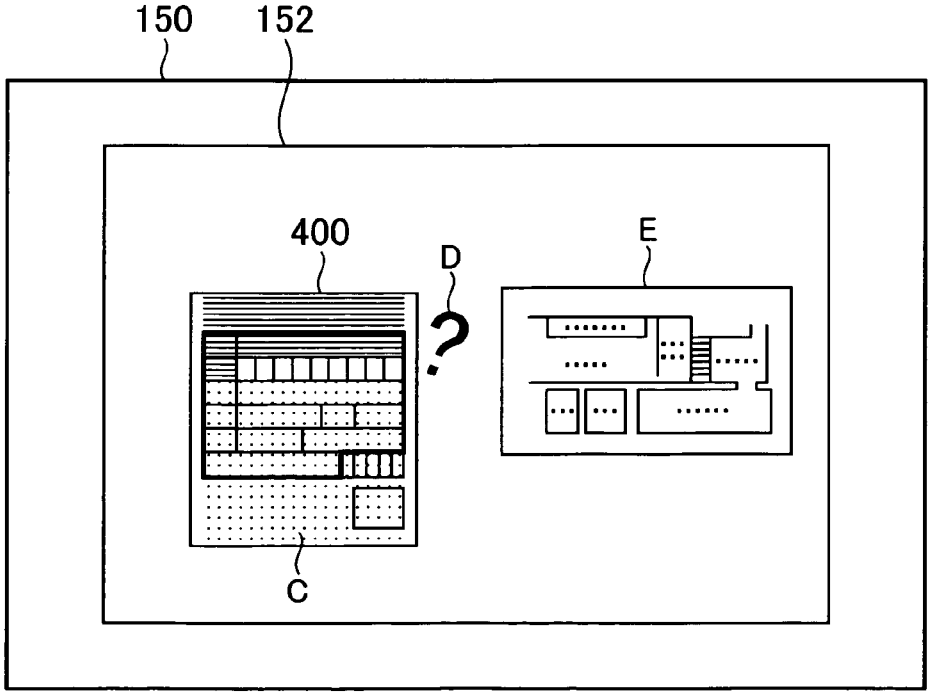


FIG. 13

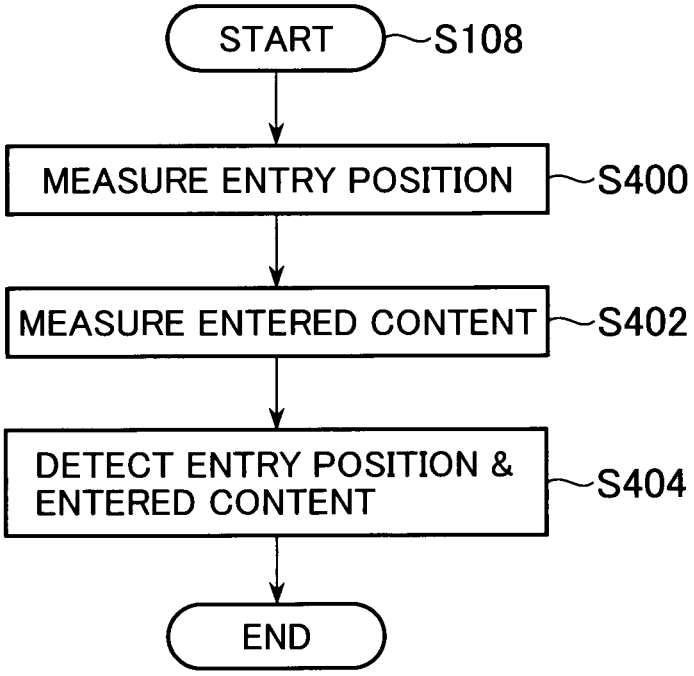

START
S108
MEASURE ENTRY POSITION
S400
MEASURE ENTERED CONTENT
S402
DETECT ENTRY POSITION & ENTERED CONTENT
S404
END

FIG. 14

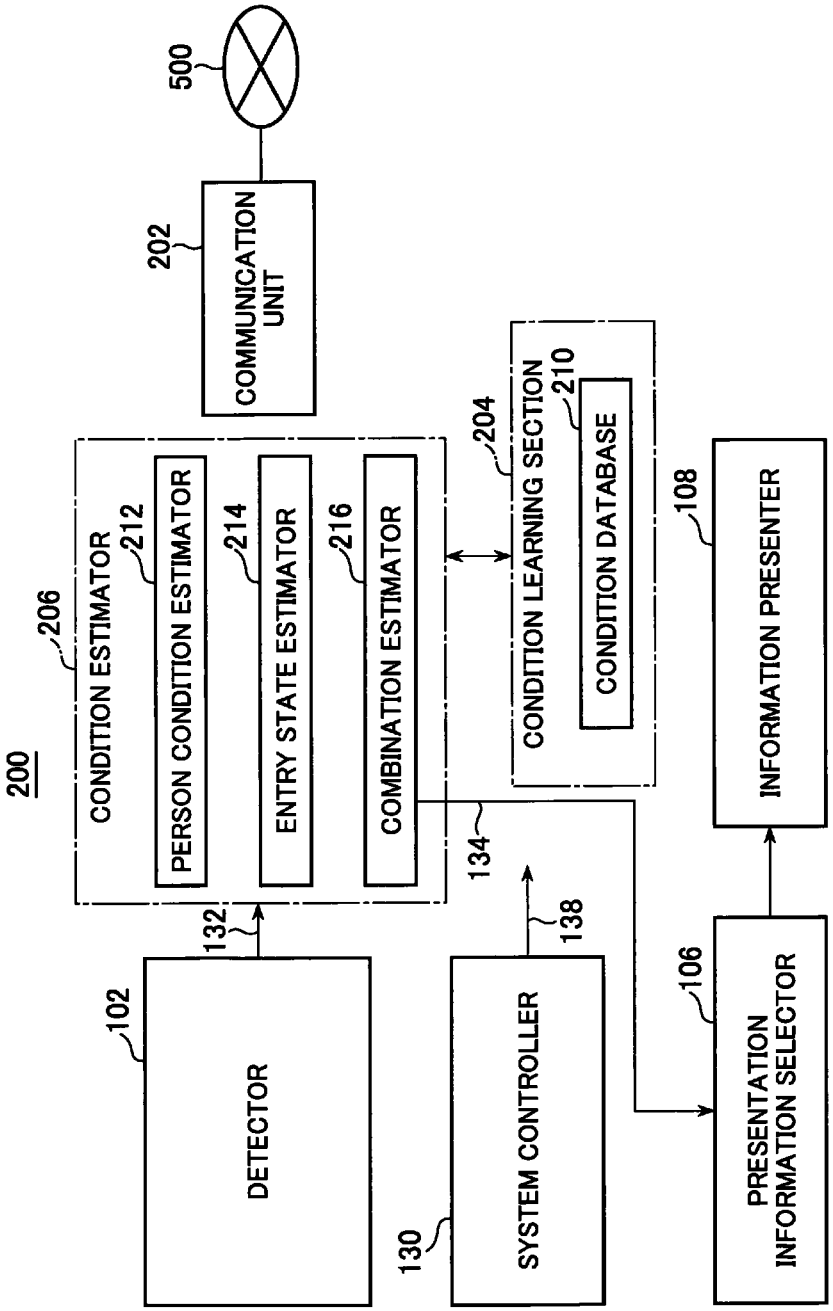

500
202
COMMUNICATION UNIT
204
CONDITION LEARNING SECTION
210
CONDITION DATABASE
108
INFORMATION PRESENTER
200
206
CONDITION ESTIMATOR
212
PERSON CONDITION ESTIMATOR
214
ENTRY STATE ESTIMATOR
216
COMBINATION ESTIMATOR
134
132
138
102
DETECTOR
SYSTEM CONTROLLER
130
106
PRESENTATION INFORMATION SELECTOR

FIG. 15

210

USER ATTRIBUTE 1	USER ATTRIBUTE 2	TIME OF DAY	CONDITION ID
20–30 YEARS OLD	MAN	10–11 O'CLOCK	3
30–40 YEARS OLD	WOMAN	14–15 O'CLOCK	2
40–50 YEARS OLD	WOMAN	9–10 O'CLOCK	2
...	...	...	...

FIG. 16

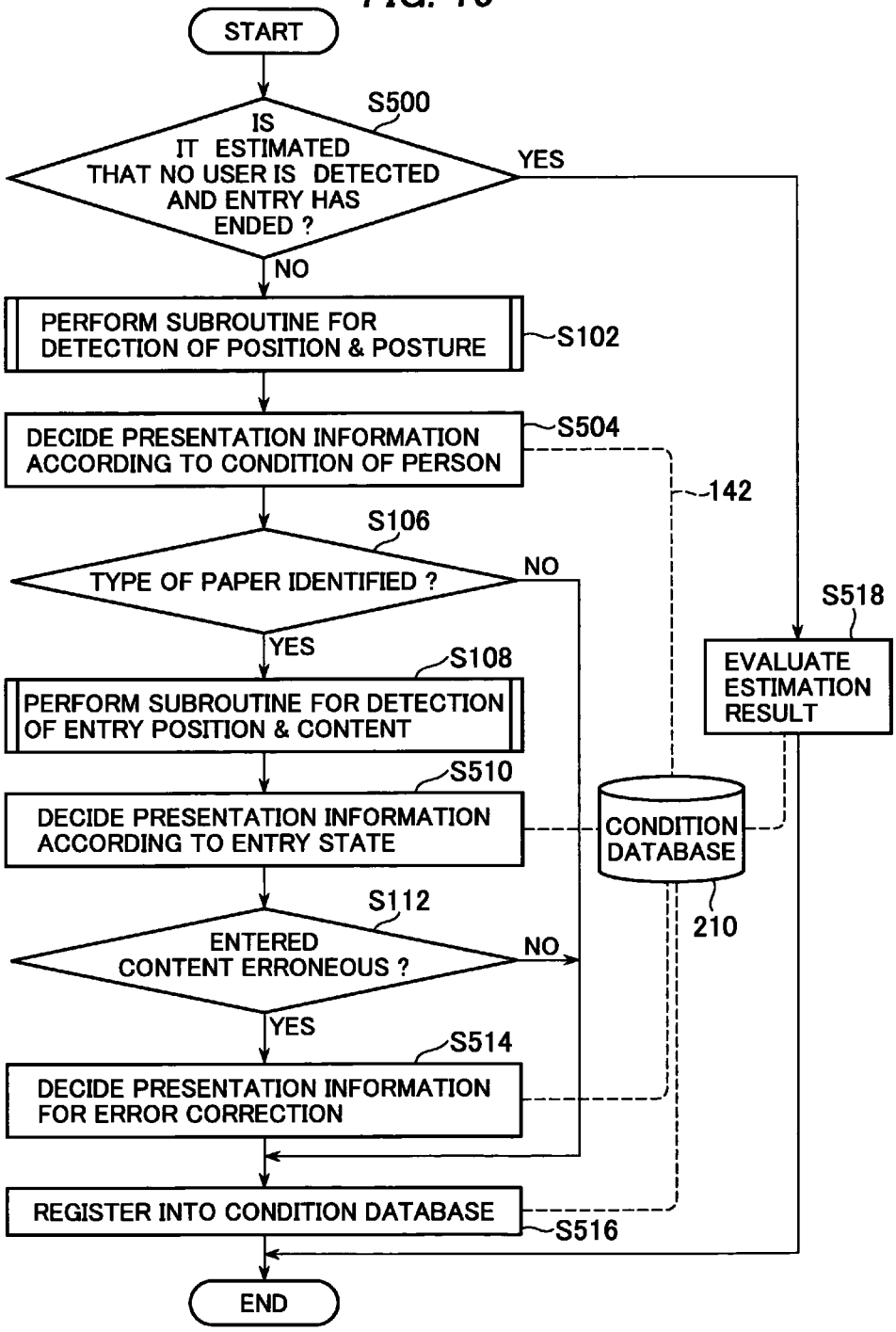
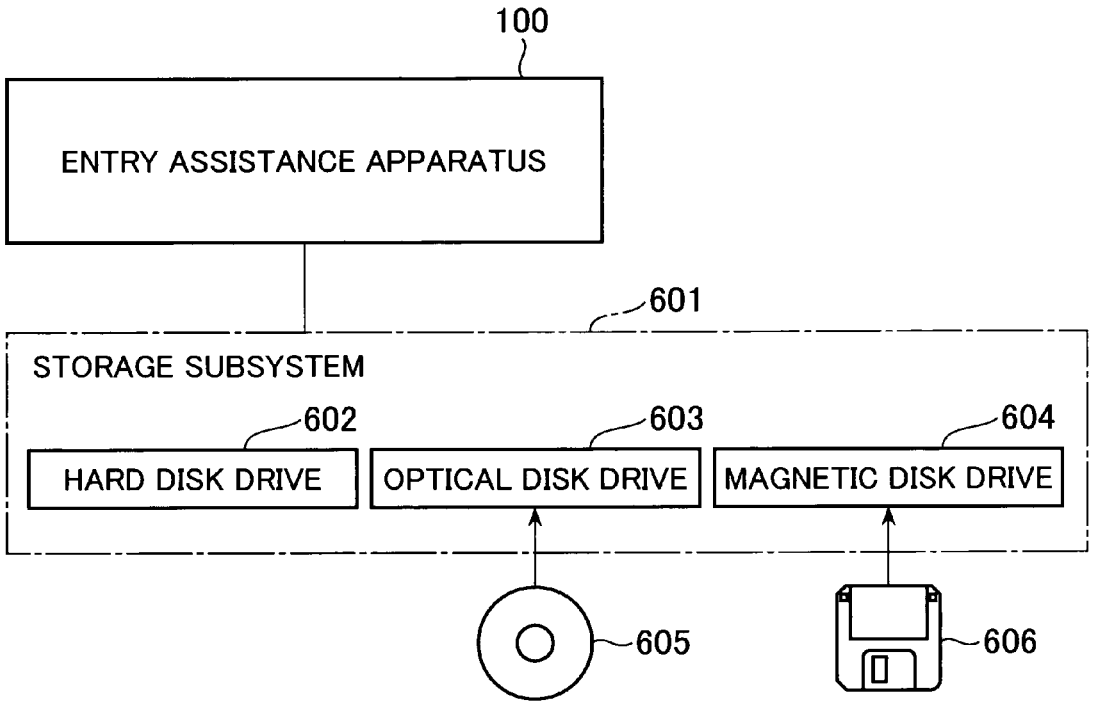

START
S500
IS IT ESTIMATED THAT NO USER IS DETECTED AND ENTRY HAS ENDED ?
YES
NO
PERFORM SUBROUTINE FOR DETECTION OF POSITION & POSTURE
S102
DECIDE PRESENTATION INFORMATION ACCORDING TO CONDITION OF PERSON
S504
142
S106
TYPE OF PAPER IDENTIFIED ?
NO
YES
S518
EVALUATE ESTIMATION RESULT
S108
PERFORM SUBROUTINE FOR DETECTION OF ENTRY POSITION & CONTENT
S510
DECIDE PRESENTATION INFORMATION ACCORDING TO ENTRY STATE
CONDITION DATABASE
210
S112
ENTERED CONTENT ERRONEOUS ?
NO
YES
S514
DECIDE PRESENTATION INFORMATION FOR ERROR CORRECTION
REGISTER INTO CONDITION DATABASE
S516
END

FIG. 17


100
ENTRY ASSISTANCE APPARATUS
601
STORAGE SUBSYSTEM
602
603
604
HARD DISK DRIVE
OPTICAL DISK DRIVE
MAGNETIC DISK DRIVE
605
606

APPARATUS FOR SENSING USER CONDITION TO ASSIST HANDWRITTEN ENTRY AND A METHOD THEREFOR

RELATED APPLICATIONS

The present patent application claims Convention priorities based upon Japanese patent application Nos. 2010-067697 and 2010-293057 filed in Japan on Mar. 24 and Dec. 28, 2010, respectively, the entire disclosure of which, including the specifications, claims, accompanying drawings and abstracts of the disclosure, is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an entry assistance apparatus, and more particularly an apparatus for assisting the user in making handwritten entry. The present invention also relates to a method in the apparatus.

2. Description of the Background Art

Computers, such as personal computers, and input devices, such as a control panel having a touch screen, allowing the users to manipulate the display screen have heretofore broadly spread. Concomitantly, the method of inputting letters and characters by the users has become more diversified. On the other hand, there still exist occasions in which the users write letters or characters by hand in order to enter the handwritten letters or characters on paper media. For example, the users may fill in paper forms prepared in shops of financial organizations, such as banks.

Under those circumstances, various solutions have been developed for processing the input of handwritten letters and characters the users provide. One of the solutions for alleviating the loads and burden imposed when handwritten letters and characters are electronically recognized or imposed on clerical processing in financial organizations is taught by Japanese patent laid-open publication No. 100672/1989 to Karahashi et al. A solution for detecting the position and angle of the sections or items on an input menu sheet for use in electronically entering characters put on the tablet of a handwritten character recognizer to thereby recognize the characters entered is disclosed by Japanese patent laid-open publication No. 2002-23938 to Mori.

Solutions for assisting the users in inputting document data have also been developed. A solution for assisting the users in producing documents having its format predetermined to include items to be filled in is disclosed in Japanese patent laid-open application No. 176015/1994 to Ishihara.

As disclosed by Karahashi et al., and Mori indicated above, the conventional solutions for processing handwritten characters the users provide intend to reduce the load imposed when the electronic equipment recognizes the user's handwritten characters by means of a digital input method using a control panel and a cursor manipulator or touch pen.

When the user or customer fills in a paper form sheet (paper medium) in a shop of a financial organization, the form may include plural items that the user has to fill in, as well as examples of entry and notanda which may often be cumbersome. That may often cause the user not to easily find out information necessary to make the entry.

However, those conventional solutions for processing the input of handwritten letters and characters the users provide are not designed to assist the users when writing text by hand. Therefore, if such conventional solutions for processing the input of handwritten letters and characters the users provide are used, it would be impossible to improve the convenience of the users when entering letters or characters through handwriting on recording media.

The conventional solutions for processing the input of handwritten letters and characters the users provide thus rely upon a digital input method by means of a control panel or a cursor pen. It would therefore be difficult to apply those conventional solutions to the users when writing on a paper medium by hand.

In the conventional solution for assisting user's input disclosed in Ishihara indicated above, when the user selects a message or exemplary sentence corresponding to items to be filled out as appropriate, information content assisting the user in inputting the selected message or exemplary sentence is displayed on the display screen.

However, in the conventional solutions for assisting the users in inputting letters or characters, information content necessary for such assistance would not be displayed on the display screen until they manipulate the machine in a prescribed manner. With those conventional solutions, burden is thus imposed on the users. Those solutions thus failed to improve the user's convenience.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a novel, improved entry assistance apparatus and a method in the apparatus capable of enhancing the convenience of the users when making handwritten entry.

In accordance with the present invention, an entry assistance apparatus for assisting the user in making handwritten entry on a recording medium comprises: a detector for detecting person condition information on a condition regarding the body of the user, the person condition information including either or both of positional information on the position of the user and postural information on the posture of the user; a condition estimator for estimating one or more conditions of the user based on the person condition information; a presentation information selector for selecting, based on the condition of the user, presentation information on one or more information contents to be presented to the user; and an information presenter for presenting the content indicated by the presentation information to the user.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more apparent from consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is an explanatory perspective view of an entry assistance apparatus in accordance with a preferred embodiment of the present invention adapted to perform an exemplified processing;

FIG. **2** is a schematic block diagram showing one example of configuration of the entry assistance apparatus of the illustrative embodiment shown in FIG. **1**;

FIG. **3** schematically shows an example of data stored in a table and is useful for understanding an example of estimation process performed by the entry assistance apparatus shown in FIG. **2**;

FIG. **4** schematically shows an example of presentation information stored in a table of the database in the illustrative embodiment shown in FIG. **2**;

FIG. **5** is a general control flowchart useful for understanding an exemplified sequence of operation performed by the entry assistance apparatus of the illustrative embodiment;

FIG. **6** is a flowchart of an example of sequence of operation of detecting positional information, performed in a subroutine of the sequence flow shown in FIG. **5**;

FIG. **7** explanatorily shows a coordinate system useful for understanding an example of sequence of operation to detect positional information in the entry assistance apparatus of the embodiment;

FIG. **8** is, like FIG. **6**, a flowchart useful for understanding an example of sequence of operation of detecting postural information, performed in the subroutine of the sequence flow shown in FIG. **5**;

FIG. **9** explanatorily shows, like FIG. **7**, a coordinate system useful for understanding an example of sequence of operation to detect postural information in the entry assistance apparatus of the embodiment;

FIG. **10** illustrate, in the form of table, another example of processing states useful for understanding the detection of postural information in the entry assistance apparatus of the embodiment;

FIGS. **11** and **12** are explanatory plan views showing examples of presentation provided by the entry assistance apparatus in accordance with the embodiment;

FIG. **13** is, like FIG. **6**, a flowchart useful for understanding an example of process of detecting an entered position and content, performed in another subroutine of the sequence flow shown in FIG. **5**;

FIG. **14** is a schematic block diagram, like FIG. **2**, showing one example of configuration of an entry assistance apparatus in accordance with an alternative embodiment of the present invention;

FIG. **15** schematically shows, like FIG. **4**, one example of data stored in a table of the condition database in accordance with the alternative embodiment shown in FIG. **14**;

FIG. **16** is a general control flowchart, like FIG. **5**, useful for understanding an example of sequence of operation performed by the entry assistance apparatus of the alternative embodiment; and

FIG. **17** is a schematic block diagram, like FIG. **2**, showing one example of configuration of an entry assistance apparatus having program storage media in accordance with another alternative embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. Throughout the present specification and drawings, like components may be designated with the same reference numerals and their repetitive description may be refrained from.

With reference first to FIG. **1**, a preferred embodiment of entry assistance apparatus **100** in accordance with the present invention may be configured in its appearance of hardware as shown in FIG. **1**. Specifically, the entry assistance apparatus **100** may comprise a desk having its desktop surface **150**, a display screen **152**, a video projector **154**, a range finder **156** adapted for measuring the distance to an object, a center of gravity (COG) sensor **158** adapted for measuring the position of the center of gravity of the user U, and a video pickup device **160** for sensing a shadow caused when the user U approaches the display screen **152**.

FIG. **1** also depicts an input device or tool **300** in the form of pen, and a paper form sheet, or entry sheet, **400** onto which the user may make a handwritten entry by means of the input tool **300** and which is now placed on the desktop surface **150**. The entry assistance apparatus **100** is adapted to detect entered-content information by sensing the entry point of the input tool **300** by means of infrared camera or cameras **140**, FIG. **2**, as will be described later on. It is to be noted that the hardware structure of the entry assistance apparatus **100** may not be restricted to the specific configuration thus shown in the figure.

Now, a brief reference will be made to FIG. **2**, which is a schematic block diagram showing the example of system configuration of the entry assistance apparatus **100**. The entry assistance apparatus **100** may generally comprise a detector section **102**, a condition estimator section **104**, a presentation information selector **106**, an information presenter **108** and a system controller **130**, which are interconnected as depicted by interconnections **132**, **134**, **136** and **138**.

The illustrative embodiment of the entry assistance apparatus **100** is depicted and described as configured by separate functional blocks as described above. It is however to be noted that such a depiction and a description do not restrict the apparatus **100** to an implementation only in the form of hardware but the apparatus **100** may partially or entirely be implemented by software, namely, by a computer, or processor system, which has a computer program installed and functions, when executing the computer program, as part of, or the entirety of, the apparatus **100**, as will be described later on. That may also be the case with alternative embodiments which will be described below. In this connection, the word "circuit", "section" or "unit" may be understood not only as hardware, such as an electronics circuit, but also as a function that may be implemented by software installed and executed on a computer.

The system controller **130**, which may be implemented by an MPU (Micro-Processing Unit) or an integrated circuit for implementing various functions, is interconnected to constituent elements of the entry assistance apparatus **100** as symbolically depicted with the connection **138**, and adapted to generally and systematically control the entire entry assistance apparatus **100**. The system controller **130** may also be adapted to serve to perform processing associated with presentation per se, the processing being conceptually depicted by the functional blocks, such as the condition estimator section **104** and the presentation information selector **106** of the apparatus **100**.

In addition to, or included in, the system controller **130**, the entry assistance apparatus **100** may have a ROM (Read-Only Memory), a RAM (Random Access Memory), and other storages, if necessary, none of which are shown. The components of the apparatus **100** are interconnected by a bus or buses serving as data transmission channels, which are symbolically shown with interconnections **132**, **134**, **136** and **138** merely for illustration.

The ROM may be adapted to store program sequences controlling the system controller **130** and control data, such as arithmetic parameters. The RAM may be adapted to temporarily store program sequences currently executed by the system controller **130** together with data. The storages may be in the form incorporated in the entry assistance apparatus **100** and adapted to store applications and various data, which may also be stored in a presentation information database **124** described later, a condition database **210**, FIG. **14**, also described later, or other storages. Such storages may be, for example, of magnetic storage media, such as a hard disk, or of a nonvolatile memory, such as a flash-type memory, which will also be described later with reference to FIG. **17**. It is to be noted that the hardware structure of the entry assistance apparatus **100** may not be restricted to the specific configuration shown described above.

Well, prior to describing the structure of the entry assistance apparatus **100** in accordance with the preferred embodiment, it will be described how illustrative embodiments assist the user in writing letters and characters by hand. In the following, it will specifically be described how the entry assistance apparatus **100** proceeds to entry assistance.

Specifically, merely for illustration purpose, an example is taken in which the user writes letters or characters by hand on a paper medium, e.g. fills out a blank form, placed on the desktop surface **150**, FIG. **1**, with aid of the entry assistance apparatus **100**. In the invention, however, the subject to be assisted by the entry assistance apparatus **100** may not be limited to handwritten entry on paper media. The entry assistance apparatus **100** can assist the user in making a handwritten entry onto an image electronically displayed on the desktop surface **150**, e.g. corresponding to a blank form.

Also, the subject of handwritten entry to be assisted by the entry assistance apparatus **100** may not be restricted to user's handwriting of actual letters or characters. The entry assistance apparatus **100** can assist the user in making a non-text entry, such as achieved by selecting one or more of plural choice items by means of, e.g. tipping or checking. In that context, the word "handwriting" may cover the possibility of such a non-textwise entry.

Further in the context, the term "character" may sometimes be comprehended broader as covering the possibility of not only character per se but also letter, mark, code, figure, symbol and sign. The term "input" may sometimes cover the possibility of electronically inputting information in a system as well as entering letters or characters, tipping or checking by handwriting on paper media, such as paper form sheets.

As described previously, in the conventional solutions for assisting the user in inputting data, information content for assisting the user would not be displayed on the display screen until he or she performs a prescribed action or manipulation. This places burden on the user. For this reason, the conventional solutions, if employed, would not ensure the convenience of the user.

When the user makes a handwritten entry in a shop of a financial organization, examples of characters that are asked to be entered may often be items associated with his or her privacy, such as personal information. When the handwritten entry by the user is assisted, it is preferable from a privacy protection standpoint that the way of presenting information to the user or the information content be varied according to the information presented to the user in such a fashion that the content of information to be concealed is not displayed for the user or items associated with privacy are not audibly presented, for example.

The entry assistance apparatus **100** in accordance with the illustrative embodiment is adapted to assist the user in making a handwritten entry by estimating the condition of the user who makes handwritten entry and presenting information content corresponding to the result of the estimation to the user in a way appropriate for the result of the estimation. This makes it unnecessary for the user to perform any special action or manipulation for prompting the entry assistance apparatus **100** to provide a presentation. Thus, the entry assistance apparatus **100** does not impose burden on the user unlike the conventional solutions, hence further enhancing the convenience of the user.

Furthermore, the entry assistance apparatus **100** can present to the user such information content which assists the user in making a handwritten entry with his or her privacy protected.

An example of information to be presented to the user, or presentation information, by the entry assistance apparatus **100** in accordance with the illustrative embodiment to assist the user in making handwritten entry may include an image depicting examples of entry, or samples, which he or she should make on a paper medium. Another example may include text indicating items or notanda to be observed in making an entry. Further examples may include a picture indicating where an erroneous entry is made, and a variety of cautionary messages.

In the present invention, information to be presented, or presentation information may not be limited to data that are presented to the user when he or she is making a handwritten entry. The entry assistance apparatus **100** may be adapted to estimate that the user is puzzled about which of paper media to select into which he or she should make an entry so as to present to him or her message stating that the officer in charge will come. That message is one example of information content which is presented to the user before he or she makes handwritten entry. The entry assistance apparatus **100** may be adapted to estimate that the user has finished an entry to in turn present him of her a map image indicating where he or she should submit the filled-in paper medium. That is one example of information to be presented to the user after completion of his or her handwritten entry.

One example of the way of presenting information content to the user by the entry assistance apparatus **100** in accordance with the illustrative embodiment may include visually display of the information on a display unit **126**, described later, included in the apparatus **100** or on a display device provided externally to the apparatus **100**.

The present invention may not be restricted to the above-described specific method of presenting information in the illustrative embodiment. Various ways of presenting information which resort to any of the human five senses can be employed by the entry assistance apparatus **100** in accordance with the embodiment. For example, such information can be presented audibly, e.g. in the form of speech and/or music, or tactually, e.g. vibrationally, changing temperature or blowing air. The entry assistance apparatus **100** may be adapted to use parameters, such as the sound level and/or direction of a sound source to thereby audibly present information, or use parameters, such as the direction and/or time interval of vibration to thereby vibrationally present information. The entry assistance apparatus **100** may also be adapted to use the distribution of temperature on the desktop surface **150** as a parameter to thereby present information in terms of temperature, and/or use parameters, such as the force and direction of blowing wind to thereby present information in terms of wind blowing.

As described above, the entry assistance apparatus **100** serves as estimating the condition of the user who makes handwritten entry and presenting information content corresponding to the result of the estimation to the user in a way appropriate for the result of the estimation. Thus, when the user makes a handwritten entry, the apparatus **100** can enhance the convenience of the user.

Specifically, the entry assistance apparatus **100** improves the convenience of the user by performing the following processing starting with a detection process (1) and ending with a presentation process (4) as described below.

(1) Detection Process

The entry assistance apparatus **100** detects information for use in estimating the condition of the user who makes handwritten entry, such information being sometimes referred to as detection information. Such detection information may exemplarily, in the illustrative embodiment, be person condition information about the condition of the body of the user, and entry state information about the state of the entry made

by the user either directly, i.e. electronically, onto a desktop surface, or onto a paper medium placed on the desktop surface. In the invention, detection information may not be limited to the above examples. The entry assistance apparatus **100** may be adapted to detect, when the user makes an entry onto a paper medium, i.e. fills in a paper form, placed on the desktop surface, information on the type of the paper medium, i.e. form sheet, from the paper medium as detection information (type-of-form information), which may be represented on the paper medium. Type-of-form information may be, in the embodiment, in the form of, for example, barcode, including QR code, recorded on paper media. In the invention, the way of appending type-of-form information to paper media may not be limited to the specific method described above.

The person condition information in the embodiment can be either or both of positional and postural information on the position and posture of the user, respectively. The entry assistance apparatus **100** can therefrom detect the position and/or posture of the user to thereby identify the physical condition of the user to be assisted. The apparatus **100** can therefore estimate, during an estimation process (2) described later, the condition of the user based on a condition corresponding to his or her physical condition thus identified.

Entry state information in the embodiment may be either or both of entry position information about a position on the desktop surface at which the user makes entry and entered-content information about the content of the entry made by the user. The entry assistance apparatus **100** can detect the position and/or content of the entry the user to be assisted makes on the desktop surface to thereby determine what he or she is entering at which position on the desktop surface or on the paper medium, namely his or her state of entry. Therefore, in the estimation process (2) described later, the entry assistance apparatus **100** can estimate the user's condition based on a condition corresponding to the identified state of entry. Furthermore, the assist apparatus **100** can use a paper medium placed on the desktop surface and identified on the basis of the type-of-form information detected from the paper medium and the result of the identification of the state of the entry made by the user to thereby determine whether or not the information entered by the user is erroneous in content.

In the detection process (1), the entry assistance apparatus **100** thus detects detection information as described previously. Detection information detected by the apparatus **100** may not be limited to including all person condition information, entry state information and type-of-form information. Rather, the apparatus **100** may be adapted to detect either one of the person condition information and entry state information as detection information. A specific method of detecting person condition, entry state and type-of-form information will be described later.

(2) Estimation Process

If detection information is detected in the detection process (1) described above, the entry assistance apparatus **100** then uses the detected detection information to estimate a single or plural conditions of the user who makes handwritten entry.

More specifically, the entry assistance apparatus **100** may use pieces of detected detection information independently of each other and/or in combination to thereby estimate one or plural conditions of the user. The apparatus **100** may be adapted to learn the results of estimation and use the results of the learning to provide estimates. Specific examples of the estimation process performed by the apparatus **100** will be described later.

The entry assistance apparatus **100** may be adapted to use person condition information or entry state information detected at plural instants of time in order to estimate the condition or conditions of the user, which is however not restrictive. The apparatus **100** can use plural pieces of person condition information or plural pieces of entry state information to thereby detect time-serial variation in person condition or entry state, and then use information about the detected time-serial variations to thereby estimate the condition or conditions of the user. The apparatus **100** may be adapted for carrying out, during the detection process (1), the aforementioned detection of information on time-serial variations. In the following, the illustrative embodiment will be described in which person condition information may contain information on time-serial variations in person condition, and entry state information may contain information on time-serial variations in entry state.

(3) Presentation Information Selecting Process

When the condition or conditions of the user are estimated in the estimation process (2), the entry assistance apparatus **100** decides or selects one or plural pieces of information to be presented, i.e. presentation information.

More specifically, the entry assistance apparatus **100** may use a presentation information database **124**, FIG. **2**, which has pieces of information on the content of, or indicated by, presentation information and a way of presentation stored in association with a result of estimation specified by, e.g. identification (ID), to thereby decide or select presentation information corresponding to the estimated condition or conditions of the user. Those pieces of information may be examples of presentation information. Examples of information about way of presentation, with the illustrative embodiment, may include textual data indicating messages to be presented to users, visual data representing still or motion pictures to be presented to users, and audio data representing speech signals to be presented to users. Information about the content of presentation may be information designating storage locations, such as file paths, at which the data are stored.

The of presentation information database may be adapted to place a priority for each estimation result such that the entry assistance apparatus **100** can adjust in the presentation process (4) described later the order and/or content of display based on the priorities so as to present information to users accordingly. The presentation information may not restrictively be provided by a specific type of database, such as a relational database (RDB).

(4) Presentation Process

If presentation information is thus decided in the selection process (3), the entry assistance apparatus **100** then uses the presentation information to thereby present to the user the content of, or designated by, the presentation information.

Where plural pieces of presentation information are selected and prioritized therebetween in the selection process (3) as described above, the entry assistance apparatus **100** may adjust, based on the priorities, and present to the user the order in which the pieces of information are to be presented to the user and/or the content of the presentation. More specifically, the apparatus **100** may present the content of, or designated by, the pieces of information to be presented to the user in the order of higher priority. If specified display sections for indicating the contents set by plural pieces of presentation information overlap with each other, the apparatus **100** may display the piece of presentation information having a higher priority in the specified display section with other pieces of presentation information lower in priority in display sections without overlapping with the specified section and with each other. If selected plural pieces of presentation information have the same priority as each other, the entry assistance apparatus **100** preferentially displays a piece of presentation

information having its identification, e.g. represented in number, smaller and showing the results of the estimation. The invention may not be restricted to the specific process, described above, performed when pieces of presentation information are prioritized.

The entry assistance apparatus **100** may perform the above-described processing starting with the detection process (1) and ending with the presentation process (4) as a specifically exemplified method of presentation in the illustrative embodiment. Those processes may thus render the entry assistance apparatus **100** estimating the conditions of the user who makes handwritten entry, and presenting information content corresponding to the result of estimation to the user in a way appropriate for the result of estimation. The entry assistance apparatus **100** can thus enhance the convenience of the user by carrying out the sequence of operation staring with the detection process (1) and ending with the presentation process (4).

Reference will be made again to FIG. **2** to further describe in detail the example of configuration of the entry assistance apparatus **100**, which is adapted for performing the aforementioned processes of presentation. In the following description, an example is taken in which the apparatus **100** assists the user U in making handwritten entry on a utility table or at a wicket in a financial organization or public institution. In the context, the word "user" may broadly cover the possibility of costumer, operator, student, and so on, who may use the apparatus **100** in a variety of applications. In the invention, the entry assistance apparatus **100** may, of course, not be limited to such a specific application.

As shown in FIG. **1**, the entry assistance apparatus **100** is equipped with the range finder **156**, COG sensor **158** and video pickup device **160**, which may in cooperation serve as part of the detector section **102**. From a systematic viewpoint, as shown in FIG. **2**, the detector section **102** comprises a position detector **110**, a posture detector **112**, an entry position detector **114**, and an entered-content detector **116**, which are adapted to play a leading role in performing the detection process (1) described above.

The position detector **110** may include an array of cameras or pressure sensors, adapted to sense the position of the user to produce positional information, which may be referred to as detection of positional information. The range finder **156**, FIG. **1**, acts as the position detector **110**. The posture detector **112** may include a laser range finder, which is adapted to sense the posture of the user to produce postural information, which may be referred to as detection of postural information. The COG sensor **158**, FIG. **1**, acts as the posture detector **112**. Thus, the position detector **110** and the posture detector **112** function as producing person condition information.

FIG. **2** merely shows one example of detector section **102** adapted to sense both positional and postural information. The invention may not be restrictive to the specific configuration of the detector section **102** described above. The entry assistance apparatus **100** may comprise none of the position detector **110** and the posture detector **112**, i.e. designed not to detect person condition information. It is also possible that the detector section **102** may have either one of the position detector **110** and the posture detector **112**, i.e. designed to detect either one of positional and postural information.

The present invention may not be restrictive to the specific configuration of the position detector **110** and the posture detector **112** described above. The entry assistance apparatus **100** can be equipped with the position detector **110** including any arbitrary device or a combination of such devices capable of identifying the position of the user. The apparatus **100** can also be equipped with the posture detector **112** including any arbitrary device or a combination of such devices capable of identifying the posture of the user.

In the illustrative embodiment, the video pickup device **160**, FIG. **1**, is provided for sensing a shadow caused when the user U approaches the display screen **152** so as to function as the entry position detector **114**. In addition to or in place of the video pickup device **160**, the entry position detector **114** may include an infrared camera or cameras **140**, which are adapted to sense an entry point of an input tool **300**, which the user uses for handwritten entry to produce entry position information, which may be referred to as detection of entry position information. With the illustrative embodiment, the input tool may exemplarily be a pen, pencil or stylus, and the entry point may be the tip of the pen, pencil or stylus. The entry position detector **114** may be adapted to read a barcode attached to a paper medium, such as a paper form sheet, placed on the desktop surface to produce type-of-form information.

The entered-content detector **116** may comprise an ultrasonic sensor and/or an infrared sensor **142**, which are adapted to detect the content of an entry made by the user to produce entered-content information, which may be referred to as detection of entered-content information. The entered-content detector **116** may be implemented by a character-recognition system using ultrasonic waves and infrared rays in combination to detect the content of the entry made by the user, the invention not being limitative to such a specific configuration. The entered-content detector **116** in accordance with the embodiment can be so configured into an arbitrary system capable of detecting the content of a handwritten entry made by the user.

More specifically, with the illustrative embodiment, the entry position detector **114** and the entered-content detector **116** are designed to produce entry state information. FIG. **2** thus exemplarily shows the detector section **102** adapted for detecting both entry position information and entered-content information, but the invention may not be limitative to the specific configuration of the detector section **102**. The entry assistance apparatus **100** can be equipped with neither the entry position detector **114** nor the entered-content detector **116**, i.e. designed not to detect entry state information. The apparatus **100** may be equipped with either one of the entry position detector **114** and the entered-content detector **116** to detect one of entry position information and entered-content information.

The detector section **102** thus includes the position detector **110**, posture detector **112**, entry position detector **114** and entered-content detector **116** to thereby perform the detection process (1) described above. The detector section **102** in accordance with the embodiment can be so configured that the sensors are shared by those components forming the detector section **102**.

The condition estimator section **104** may comprise a person condition estimator **118**, an entry state estimator **120** and a combination estimator **122**, which are adapted to perform the estimation process (2) described above. Specifically, the condition estimator section **104** is adapted to be responsive to the detection information **132** transferred from the detector section **102** to estimate one or more conditions of the user who makes handwritten entry to in turn transfer identification information on the result of the estimation **134** to the presentation information selector **106**. In the following, identification information may be referred to as "condition identification (ID)". Information, signals or data are designated with reference numerals of connections on which they are conveyed.

The person condition estimator **118** functions to use person condition information relating to the condition or conditions

of the body of the user and transferred from the detector section **102** to thereby estimate the condition or conditions of the user.

The person condition estimator **118** functions as estimating, when the position of the user indicated by the transferred positional information does not lie within a predetermined range, that the position of the user is off his or her normal entry position. In such a condition, the entry assistance apparatus **100** will provide a presentation such as to guide the user to the predetermined range. When the transferred postural information indicates that the user tilted his or her head several times, the person condition estimator **118** estimates that he or she is searching for an officer in charge. In such a condition, in order to inform an officer in charge that the user is searching for an officer, the entry assistance apparatus **100** provides a visual notice by lighting a lamp on, or provides an audible notice in oral or sound. When a visual or audible notice is provided as described as above, the entry assistance apparatus **100** additionally gives a notice to that effect to the user. When transferring the positional and postural information, the person condition estimator **118** can provide estimates independently based on the positional and postural information of each other. Alternatively, the estimates can also be provided by combining the positional and postural information with each other. The invention may not be limitative to the specific way of estimation provided by the person condition estimator **118** described above.

The entry state estimator **120** serves to use entry state information on the state of the entry, transferred from the detector section **102**, to estimate the condition of the user.

When the entry position indicated by the entry position information transferred is not in a predetermined range, the entry state estimator **120** estimates that the user stays out of his or her entry position. In that case, the entry assistance apparatus **100** provides an error or warning message to the user. The entry state estimator **120** can also use the detected type-of-form information to estimate whether or not the entry position is off the fill-in columns on the paper form. The estimator **120** uses the entered-content information transferred to estimate whether or not the entered content is erroneous. When the user has written his or her address erroneously, for example, when the address includes a written content not matching any geographical name actually existing, the estimator **120** estimates that the entered content is in error. In that case, the entry assistance apparatus **100** presents an error or warning message to the user. The entry state estimator **120** may be adapted to provide, when supplied with entry position and content information, estimates independently based on those two types of information of each other as described above. Alternatively, it is also possible to provide estimates by combining the entry position and content information with each other. The invention may not be restrictive to the specific estimates, described above, provided by the entry state estimator **120**.

The combination estimator **122** functions to be responsive to the person condition and entry state information to provide an estimate of the condition of the user.

When the postural information indicates the position of the center of gravity, the combination estimator **122** determines the position of the center of gravity and its dispersion with respect to predetermined threshold values to determine how much the user leans forward, i.e. the degree of forward leaning of the user. For example, the degree may be classified into three levels: high, moderate and low. The estimator **122** uses the identified degree of forward leaning of the user, the position of the user indicated by the positional information, and the entry position indicated by the entry position information to estimate into which fill-in column on the desktop surface **150** the user is making an entry. In addition, the combination estimator **122** can also use the detected type-of-form information to estimate into which fill-in column on the paper form placed on the desktop surface **150** the user is making an entry.

The combination estimator **122** may be adapted to further use, if the estimator **122** estimates that the entered content is in error based on the entered-content information, the degree of forward leaning of the user to provide an estimate of the condition of the user. In that case, if the amount of forward leaning of the user is larger, then the combination estimator **122** estimates that the user is unconscious of the entry error, i.e. in the condition that the user needs to be alerted. By contrast, when the amount of forward leaning of the user is smaller, then the combination estimator **122** estimates that the user is puzzled about which kind of information he or she has to enter. That means the circumstances where a message prompting calling of the officer in charge is possibly be necessary.

The combination estimator **122** thus estimates the condition of the user by providing, as described above, stepwise estimates of conditions regarding the user's body and of the entry state. The estimator **122** can accomplish the stepwise estimates by using an identification method, such as a support vector machine (SVM) that is a two-class pattern identification device.

Note that the present invention may not be limitative to the estimation method specifically implemented by the combination estimator **122** described above. The estimator **122** can be adapted to use a combination of the results of decisions separately made from each other under preset conditions to estimate the condition of the user. More specifically, the estimator **122** has plural sets of conditions set up regarding the conditions of the body of the user and the entry states, and uses the person condition and entry state information transferred to make decisions as to whether or not the plural sets of conditions are met independently of each other. The estimator **122** uses in combination the results of the decisions made under the separate conditions to estimate the condition of the user.

Now, reference will be made to FIG. **3**, which illustrates one example of estimation process performed by the entry assistance apparatus **100** in accordance with the embodiment. In the figure, an example of table is shown which is used by the entry assistance apparatus **100**, more exactly the condition estimator section **104**, to estimate the condition of the user. As shown, the exemplified condition of the user to be estimated by the condition estimator section **104** may include "a condition that the user has started to fill in a form", "a condition that the user is puzzled about which form to select", and "a condition that the user is puzzled about into which form field the user should make an entry". The conditions of the user estimated by the entry assistance apparatus **100** may not be restrictive to the examples shown in FIG. **3**. For instance, the entry assistance apparatus **100** may assume various conditions including "a condition that the user is making an entry into the form" and "a condition that the entry into the form is erroneous".

Conditions 1, 2, 3 and so forth shown in FIG. **3** are what are estimated by the condition estimator section **104** based on person condition and entry state information. The combination estimator **122** included in the condition estimator section **104** uses the person condition or entry state information transferred from the detector section **102** to make a decision as to whether the conditions are met (true (T)) or not (false (F)) in FIG. **3**. Thus, the estimator **122** determines, as an estimate, a condition corresponding to a combination of the results of the

decisions as a condition of the user, which is depicted in the column "Estimated Condition" in FIG. **3**.

The condition in which the user is puzzled about into which form field he or she should make an entry arises when the following four conditions (a) through (d) are satisfied: (a) the position of the user indicated by positional information is within a predetermined range in which he or she can write, (b) the posture indicated by postural information permits the user to write, (c) the entry position indicated by entry position information permits the user to make an entry, and (d) the entered content indicated by entered-content information keeps itself without varying in a predetermined period of time, e.g. several seconds.

The combination estimator **122** included in the condition estimator section **104** can reference data stored in the form of table as shown in FIG. **3** to use in combination the results of decisions made under separate conditions to thereby estimate the condition of the user.

The present invention may not be restrictive to the specific table thus used by the condition estimator section **104** as described above to estimate the condition or conditions of the user. The estimator section **104** can estimate the same condition of the user as his or her different condition by making the same condition of the user associated with a combination of different conditions. For example, when the entered content is erroneous, if the entry error does not exceed (or is below) a predetermined threshold value, then the estimator section **104** estimates the condition as a condition that a cautionary message should be presented. If the entry error exceeds (or not lower than) the threshold value, then the condition estimator section **104** presents a message for effecting that an officer in charge will be called. The estimator section **104** can thus assign the same condition of the user to a different condition identification according to a combination of conditions to thereby provide a different presentation under the same condition of the user.

In a case where the entry assistance apparatus **100** has a function of using the entered content of the user, such as name or account number, to acquire attribute information on the attributes of the user, such as age or sex, the condition estimator section **104** can treat a condition associated with a piece of attribute information as an estimation condition to thereby make the same condition of the user correspond to a combination of different conditions. Thus, the condition estimator section **104** can adjust a content to be presented and/or a way of presentation to the user according to an attribute, such as an age group to which the user belongs, even under the same condition of the user.

The condition estimator section **104** thus comprises the person condition estimator **118**, entry state estimator **120** and combination estimator **122** to thereby perform the estimation process (2) described above. The present invention may not be limitative to such a specific structure of the condition estimator section **104** as to comprise the person condition estimator **118**, entry state estimator **120** and combination estimator **122**. The estimator section **104** can be configured to include any one or more of the person condition estimator **118**, entry state estimator **120** and combination estimator **122** in compliance with the configuration of the detector section **102**.

Referring again to FIG. **2**, the exemplified configuration of the entry assistance apparatus **100** of the illustrative embodiment will continue to be described. The presentation information selector **106** serves as performing the presentation information selecting process (3). Specifically, the selector **106** is adapted for referencing the presentation information database **124** storing presentation information to decide, or select, presentation information corresponding to an estimated condition of the user.

FIG. **4** shows an exemplified format of table storing presentation information in the presentation information database **124**. In the database **124**, data are described in a language, such as XML (Extensible Markup Language), setting forth meanings and structures. The invention may not restrictive to the presentation information database **124** described in such a specific language as XML.

The column "Condition ID" in FIG. **4** is a field for storing identification information identifying a result of estimation provided by the condition estimator section **104**. The presentation information selector **106** can use a condition identification (ID) **134** transferred from the condition estimator section **104** to search the presentation information database **124** to thereby identify presentation information appropriate for the result of estimation provided by the condition estimator section **104**.

In FIG. **4**, the column "Type of Presentation Information" is a field for storing the sort of a content of, or indicated by, presentation information, such as message or alert (cautionary message). The column "File Name" is a field for storing the name of a data file containing the content of presentation information. The file name may be exemplary. In addition thereto or in place thereof, a file path indicating a storage location at which the file is stored may be stored. Examples of messages to be presented may include "Welcome to the bank" or "Please make an entry here" at the start of servicing, and "Thank you very much" at the end of servicing. Alerting messages may be, for example, ones highlighting an erroneously filled-out blank when the entered content is in error, and calling a clerk in charge when the user is puzzled about what he or she has to enter.

The present invention may not be restricted to the contents of the messages indicated by presentation information described above. The entry assistance apparatus **100** can present examples of item of entry to be made by the user as well as advertisements as in the form of digital signage.

The column "Specified Display Section" in FIG. **4** is a field for storing location data designating the feature of a display section, such as area or shape, on a display screen **152**, FIG. **1**, of the display unit **126**, described later, which will be used to display the content of presentation information. The column "Priority" in the figure is a field for storing an index indicating how important presentation information is, namely the degree of importance of presentation information. As described previously, the entry assistance apparatus **100** adjusts the order and/or content of presentation based on the priority set in presentation information. Use of the presentation information database **124** as shown in FIG. **4** permits the entry assistance apparatus **100** to employ a view management procedure based upon priorities to thereby provide the user with the content of presentation information.

The priorities may be set in advance as shown in FIG. **4**. However, that may not be limitative. For example, the entry assistance apparatus **100** may be adapted for obtaining attribute information on the attribute of the user to adjust the priority based on the attribute information. For instance, when the age derived from attribute information reveals the user to fall in a senior age class, the entry assistance apparatus **100** may set higher the priority of presentation information whose content is that displayed characters are larger.

The presentation information selector **106** uses a condition identification **134** transferred from the condition estimator section **104** to reference the presentation information database **124** as shown in FIG. **4** to select one or more pieces of

presentation information. In the invention, presentation information may not be restricted to what is specifically shown in FIG. **4**. Presentation information may further include away of presentation and parametric information on presentation, such as the volume and direction of a sound source as described earlier.

The presentation information selector **106** may be adapted for managing the presentation of information to be presented by the information presenter **108**. Specifically, the selector **106** may produce and transfer control signals for starting the presentation of the content of, or indicated by, presentation information, arranging the content or way of display, and stopping the presentation of the content to the information presenter **108**, thereby managing the presentation of information to be presented by the information presenter **108**.

Referring again to FIG. **2**, in the exemplified configuration of the entry assistance apparatus **100**, the information presenter **108** performs the presentation process (4) described earlier. More specifically, the information presenter **108** is adapted for being operative in response to a control signal **136** transferred from the presentation information selector **106** to present presentation information corresponding to that control signal, arrange the content of presentation, or stop the presentation. The information presenter **108** may include a storage, not shown, in which various data representing the content of presentation information are stored. When presentation information is presented, the information presenter **108** may appropriately read out information to be presented from the storage based on the control signal transferred. The presenter **108** processes, e.g. decodes, the presentation information thus read out for presentation.

In the illustrative embodiment shown in FIG. **2**, the information presenter **108** includes the display unit **126** capable of visually presenting the content of information to be presented to the user. The display unit **126** may be a liquid crystal display (LCD) or an organic electroluminescence display. In the illustrative embodiment, the display unit **126** is implemented, as shown in FIG. **1**, by a video projection system including the display screen **152** and projector **154** adapted to project images on the screen **152**. In place of the video projection system, an electronic paper is applicable to the display unit **126**. The display unit **126** may also be implemented into a touch screen that the user can manipulate to make manual entry.

The present invention may not be restrictive the specific configuration of the information presenter **108** shown in FIG. **2**. The presenter **108** may include a DSP (Digital Signal Processor) and an audio output device configured to include an amplifier and loudspeakers. In such a configuration, the entry assistance apparatus **100** can provide an audible (auditory) presentation. The information presenter **108** may have devices for implementing various kinds of presentation information which resort to any of the human five senses, such as tactile presentation, e.g. vibration, temperature change or wind blow.

The configuration specifically shown in and described with reference to FIG. **2** allows the entry assistance apparatus **100** to perform the processing starting with the detection process (1) and ending with the presentation process (4), thus enhancing the convenience of the user, when making a handwritten entry.

The entry assistance apparatus **100** may not be restricted to the specific configuration shown in FIG. **2**. The apparatus **100** may include a communication unit **202**, FIG. **14** and described later on, adapted to communicate with an external device directly or over a telecommunications network.

Well, in a specific application, the entry assistance apparatus **100** will proceed to the entry assistance operation as will be described below. In operation, for example; the apparatus **100** may detect person condition information, entry state information and type-of-form information. Further in operation, the apparatus **100** may detect person condition information including both positional and postural information, as well as entry state information including both entry position and content information.

The operation will be described of the entry assistance apparatus **100** when exemplarily equipped with such infrared cameras **140** with reference to FIG. **5**, a flowchart illustrating an example of sequence of operation performed by the apparatus **100**.

First in step S**100**, the entry assistance apparatus **100** determines whether or not the user has been sensed. The apparatus **100** manages such determination as to whether the user has been detected by using a flag, for example.

More specifically, if it is determined that the pressure value sensed by the COG sensor **158** is in excess of a predetermined threshold value, then the entry assistance apparatus **100** determines that the user has been detected. The apparatus **100** in turn sets the flag ON to indicate that the user has been detected. This condition of the flag is maintained until it is determined that the user is no longer detected. If it is determined that the pressure value is no longer in excess of the predetermined threshold value, then the entry assistance apparatus **100** resets the flag to indicate that no user is detected. This condition of the flag is maintained until it is determined that the user is again detected.

When the user is standing in front of the entry assistance apparatus **100**, i.e. on the COG sensor **158**, the COG sensor **158** produces a pressure value exceeding the threshold value because of the weight of the user. The apparatus **100** is thus adapted to set in this condition the flag to indicate that the user has been detected.

The present invention may not be limitative to the specific method described above of sensing the user by the entry assistance apparatus **100** in the instant embodiment. The apparatus **100** can also sense the user using the range finder **156** functioning as the position detector **110**. Specifically in that case, the apparatus **100** may be adapted to determine that the user has been detected provided that the distance value (an example of positional information) sensed by the range finder **156** becomes smaller than the predetermined threshold value and maintains itself for a predetermined period. Alternatively, plural imagers, not shown, serving as the position detector **110** may be arranged around the desktop surface **150** to capture an image therearound to compare the image with a reference image taken or prepared when no person appears around the apparatus **100** to thereby detect the user. More specifically, the entry assistance apparatus **100** may detect the user by applying a background subtraction or a skin color detection procedure to the reference image and the image currently taken.

If, in step S**100**, no user has been sensed, then the entry assistance apparatus **100** does not proceed until the presence of the user is detected.

In step S**100**, if it is determined that the user has been detected, the entry assistance apparatus **100** performs the processing subroutine S**102** for detecting the position and posture of the user to produce positional and postural information.

An example of subroutine for detecting the position and posture of the user will be described. For example, an exemplified subroutine for detecting positional information will proceed in the following fashion. The entry assistance appa-

ratus **100** uses the result of the detection made by the COG sensor **158** to detect the position of the user. In general, the number of points from which a pressure is sensed by the COG sensor **158** depends upon the shape of the shoes the user wears. It is, however, possible to set a threshold value for detection within a reasonable range of human weights to thereby estimate the shape of the user's feet from the position of a point exceeding (or not lower than) the threshold value. The entry assistance apparatus **100** may rely upon such a way of estimation to detect that the user is standing at the estimated position.

FIGS. **6** and **7** are useful for understanding one example of process performed by the entry assistance apparatus **100** in accordance with the embodiment to detect positional information. In this example illustrated in FIGS. **6** and **7**, the entry assistance apparatus **100** detects the position of the user based on the result of detection made by the COG sensor **158**.

In step S**200**, the entry assistance apparatus **100** makes a determination as to whether or not a region is detected in which the COG sensor **158** has sensed a pressure value in excess of the threshold value and which has an area equal to or broader than a predetermined value. Unless it is determined in step S**200** that such a region is detected, the apparatus **100** does not proceed to further control until it determines such a region detected.

If it is determined in step S**200** that pressure values exceeding the threshold value have been detected in a region equal to or broader in area than the predetermined value, then the entry assistance apparatus **100** calculates the position of the center of gravity of this region (S**202**). The apparatus **100** detects the calculated position of the center of gravity as the position of the user. FIG. **7** shows an example of position of the center of gravity computed by the assist apparatus **100**. The apparatus **100** is adapted to represent the position of the center of gravity on a coordinate system whose origin lies at a predetermined position on the COG sensor **158**.

The entry assistance apparatus **100** thus follows the processing steps illustrated in FIG. **6** to thereby detect the position of the user to produce positional information, which is coordinate data representing the position of the center of gravity.

In the present invention, the specific processing in the entry assistance apparatus **100** for detecting the position described above may not be restrictive. The apparatus **100** may be adapted to use a distance value detected by the range finder **156** to correct the position of the center of gravity. The apparatus **100** may use the distance value detected by the range finder **156** as positional information.

An example of procedure of detecting postural information will be described. When positional information is detected, the entry assistance apparatus **100** uses the COG sensor **158** to detect postural information. Specifically, the apparatus **100** uses the distribution of pressure values detected around the detected position to calculate therefrom the position of the center of gravity of the body of the user and the variance of the distribution of pressures to take the calculated values as postural information.

FIGS. **8** and **9** are useful for understanding an example of sequence of operation performed by the entry assistance apparatus **100** to detect postural information. In this example, the apparatus **100** uses the result of detection made by the COG sensor **158** to detect the posture of the user. In FIG. **9**, coordinates (x_1, y_1) and (x_2, y_2) indicate the positions of centers of gravity. Coordinates (x_3, y_3) and (x_4, y_4) indicate the position at which the pressure is maximal, the position being sometimes referred to as the maximum-pressure position.

Now, in FIG. **9**, in step S**300**, the entry assistance apparatus **100** computes the Euclidean distance between the position of the center of gravity and the maximum-pressure position.

If the Euclidean distance is computed in step S**300**, the entry assistance apparatus **100** makes a decision as to whether the Euclidean distance is equal to or higher than a threshold value α (S**302**), which is a first threshold value to determine the degree of forward leaning of the user, from which it is determined whether or not the amount of forward leaning is small.

Then in step S**302**, unless it is determined that the Euclidean distance is equal to or higher than the threshold value α, then the entry assistance apparatus **100** proceeds to step S**304** to determine that the amount of forward leaning is small. The apparatus **100** in turn produces postural information appropriate for the result of the decision (S**312**), and the processing will be terminated.

If it is determined in step S**302** that the Euclidean distance is equal to or higher than the threshold value α, then the entry assistance apparatus **100** makes a decision in step S**306** as to whether or not the Euclidean distance is equal to or higher than a threshold value β, which is a second threshold value to determine how much the user leans forward, where the second threshold value is higher than the first threshold value. It is thus determined whether or not the amount of forward leaning is moderate.

In step S**306**, unless it is determined that the Euclidean distance is equal to or higher than the threshold value β, then the entry assistance apparatus **100** determines in step S**308** that the amount of forward leaning is moderate. The apparatus **100** in turn produces postural information appropriate for the result of the decision (S**312**), and then the processing is terminated.

If it is determined in step S**302** that the Euclidean distance is equal to or higher than the threshold value β, then the entry assistance apparatus **100** determines that the amount of forward leaning is great (S**310**). The apparatus **100** then produces postural information appropriate for the result of the decision (S**312**) and terminates the processing.

The entry assistance apparatus **100** thus proceeds to the processing subroutine illustrated in FIG. **8** to thereby make a decision concerning how much the user is tilted toward the apparatus **100**, i.e. toward the desktop surface **150**. Values of the amount of forward leaning are clustered. The apparatus **100** produces postural information on the result of the clustering, for example, in the form of data indicating the degree of the forward leaning.

The specific detection process performed by the entry assistance apparatus **100** to detect postural information as described above may not be restrictive. The apparatus **100** can also be adapted to use the range finder **156** functioning as the posture detector **112** to sense the position of the head of the user with respect to a reference position on the desktop surface **150** to thereby detect the posture of the user from the position of the head. More specifically, the entry assistance apparatus **100** holds data of the detected position of the head, and calculates the moving speed of the head position from time-serial data about the head position to thereby detect postural information carrying values indicative of how much the user leans forward and how much his or her head is tilted when he or she is in the standing posture.

Now, reference will be made to FIG. **10**, which shows a table useful for understanding another example of detection process for detecting postural information by the entry assistance apparatus **100** in accordance with the illustrative embodiment. The example illustrated in FIG. **10** is directed to

the entry assistance apparatus **100** adapted to use the results of detection done by the range finder **156** to detect the posture of the user.

In the example, the entry assistance apparatus **100** is adapted for producing postural information according to combinations of various items shown in the table of FIG. **10**. Specifically, the entry assistance apparatus **100** uses distance values detected by the range finder **156** to establish a human body model of the upper half of the body of the user. The apparatus **100** selects one of the human body models made correlative in advance to distance values which is associated with a distance value detected by the range finder **156** to thereby establish a human body model. The apparatus **100** then calculates a position that can be estimated as the position of the head on the established human body model. Then, the apparatus **100** traces the calculated head position, while shifting as the user moves, to estimate how the user has moved his or her the head position to thereby estimate the degree of forward leaning through the threshold processing subroutine illustrated in and described with reference to FIG. **8**.

The present invention may not be restrictive to the above-described procedure of estimating the movement of the head position by tracing variation of the position that can be estimated as the head. For example, the entry assistance apparatus **100** may be adapted to sense variation in position of the whole upper half of the body to thereby indirectly estimate the position of the head of the user.

In FIG. **10**, the moving speed of the head is represented with respect to any one or all of the X-, Y-, and Z-axes on the coordinates. Where the entry assistance apparatus **100** is designed to sense only forward leaning of the user, the apparatus **100** may calculate the moving speed on the axis substantially perpendicular to the apparatus from the head position. Where the apparatus **100** is adapted to sense the posture of the user in his or her left-and-right direction, the apparatus **100** may compute the moving speed on the axis substantially parallel to the apparatus from the head position. From the moving speed thus calculated, the apparatus **100** estimates how the moving speed is, i.e. the degree of moving speed, through the threshold processing subroutine illustrated in FIG. **8**.

The acceleration in movement of the head shown in FIG. **10** may be computed from the moving speed of the head. From the acceleration in movement of the head thus calculated, the entry assistance apparatus **100** may estimate how the acceleration is, i.e. the degree of the acceleration in movement of the head, through the threshold processing subroutine shown in FIG. **8**.

The droopy posture of the user can be represented by the position, moving speed and acceleration in movement of the head. However, the entry assistance apparatus **100** can represent how the head is tilted as shown in FIG. **10**. The apparatus **100** may form the values of the position, moving speed and acceleration in movement of the head in the postural information. If the human body model differs in tallness from the user to be detected, the apparatus **100** can enlarge or reduce the human body model of the upper half portion so as to more accurately calculate the values of the position, moving speed and acceleration in movement of the head. The degree of the tallness of the user to be detected can be estimated by sensing his or her eyes from images taken by the imagers, not shown, arranged around the desktop surface **150**. That specific method of estimating the user's tallness may not be restrictive.

The entry assistance apparatus **100** thus performs the processing described above to detect positional and postural information as person condition information. The present invention may not be restrictive to the processing for detecting the position and posture described above.

Referring back to FIG. **5**, the example of processing performed by the entry assistance apparatus **100** will continue to be described. When the subroutine S**102** for detecting the position and posture has been carried out, the entry assistance apparatus **100** proceeds to step S**104** in which the apparatus **100** utilizes the detected person condition information to select information to be presented according to the condition of the person. The apparatus **100** selects presentation information through the estimation process, or subroutine, (2) and the process (3) for selecting presentation information as described above.

The entry assistance apparatus **100** then uses the selected presentation information so as to present the content of, or indicated by, the information thus selected to the user through the presentation process (4) described above. Whenever presentation information is selected as described above, the apparatus **100** performs the presentation process. However, that specific way of processing may not be limitative. The apparatus **100** may present the content of selected presentation information after the processing described with reference to FIG. **5** is completed. In addition, the content of presentation information thus selected may periodically be presented, rather than once.

Examples of presentation will be described with reference to FIGS. **11** and **12**, which illustrate in plan views examples of presentation provided by the entry assistance apparatus **100**. FIG. **11** shows an example of content of presentation information which is visually offered to the user when it is estimated that he or she is currently making an entry. FIG. **12** shows an example of presentation information which is also visually offered to the user when it is estimated that he or she has finished entry.

As seen from FIG. **11**, when it is estimated that the user is currently making an entry, the entry assistance apparatus **100** presents, i.e. displays, the contents A and B of presentation information on the display screen of the desktop **150** around the paper form sheet **400**. The presentation A provides an example of entry, or sample, on a paper form corresponding to the paper form sheet **400**. The presentation B provides notes to be observed when an entry is made.

One example of the case where it is estimated that the user is currently making an entry may be when the position indicated by detected positional information is located within a predetermined range set on the COG sensor **158** and the position estimated as the head of the user based on the range finder **156** lies on the desktop surface **150**. The predetermined range on the COG sensor **158** may be, for example, the half of the sensing region of the COG sensor **158** closer in FIG. **1** to the entry assistance apparatus **100**. The method to estimate that the user is currently making an entry may not specifically be restricted to what is implemented by the apparatus **100** as described above. The apparatus **100** can enhance the estimation accuracy by combining pieces of information about written characters that are discriminated using stroke information obtained from the motion of the input tool **300**, as disclosed by, for example, Mori cited earlier.

When it is estimated that the user has finished making an entry and the entered content is in error, the entry assistance apparatus **100** highlights, as shown in FIG. **12**, the erroneous portion C of the entered content on the paper form sheet **400** and issues an alerting message as in the form of mark "?". If it is estimated that the user has complete the entry, the entry assistance apparatus **100** presents a way E such as to inform the user where he or she should submit the entry sheet **400** thus he or she has put on record.

It may be estimated that the user has finished making an entry when, for example, the position indicated by the detected positional information is located within a predetermined range on the COG sensor **158** and the position estimated as the head of the user based on data derived from the range finder **156** is not on the desktop surface **150** or spaced more than a predetermined distance from the desktop surface **150**. The predetermined range on the COG sensor **158** may be, for example, the central region on the COG sensor **158** shown in FIG. **1**. The entry assistance apparatus **100** may be arranged to estimate, when an action, such as a stretch, of the user is detected from the result of detection of the position estimated as the head of the user, that the user has completed the entry. It may be estimated that the entered content is in error when, for example, stroke information obtained from the motion of the input tool **300** indicates a marking-out action and an action of drawing an erasure line. The apparatus **100** can enhance the estimation accuracy by combining various pieces of information about the motions.

The entry assistance apparatus **100** thus uses the detected position and posture and time-serial variations in position and posture of the user to estimate the condition of the user, and presents presentation information appropriate for the result of estimation to the user, as shown in FIGS. **11** and **12**, such as alert and presentation of examples or templates of entry items necessary to make a handwritten entry that is recognized on a real-time basis. Visual representation that may be provided by the entry assistance apparatus **100** may not be restricted to the examples shown in FIGS. **11** and **12**.

Referring again to FIG. **5**, the entry assistance apparatus **100** will further continue the exemplified processing. When step S**104** is performed, the apparatus **100** advances to the step S**106** of making a decision as to whether or not the type of paper has been identified. If type-of-form information has been detected from the paper form sheet and the type of the paper form sheet or paper medium indicated by the detected type-of-form information can be identified, then the apparatus **100** concludes that the type of the paper form sheet is determined. The apparatus **100** images a barcode (an example of type-of-form information) printed on the rear surface of the paper form sheet **400** by means of the video pickup device **160**, and identifies the type by means of the processor, not specifically shown. In turn, the apparatus **100** uses the type-of-form information and consults with a table in which the type of the paper form sheet (paper medium), positions of items to be filled in, contents and so on are interrelatedly stored to paper medium information, and identifies a paper form sheet corresponding to the detected type-of-form information. The invention may not be restrictive to that specific procedure performed by the apparatus **100** as described in step S**106**.

In step S**106**, unless it is determined that the type of the paper form sheet has been identified, the entry assistance apparatus **100** terminates the processing routine illustrated in FIG. **5**. The routine shown in FIG. **5** may not be one-time processing but repetitively performed.

If, in step S**106**, it is determined that the type of the paper form sheet has been identified, the entry assistance apparatus **100** performs the subroutine S**108** for detecting the entry position and content to detect entry positional and content information.

An example of subroutine for detecting the entry position and content will be described with reference to FIG. **13**, which illustrates in a control flowchart an example of subroutine the entry assistance apparatus **100** performs to detect the entry position and content of an entry.

The entry assistance apparatus **100** measures an entry position (S**400**) and an entered content (S**402**), and detects an entry position and an entered content based on the results from the measurements (S**404**). The apparatus **100** may perform the the method disclosed in, for example, in the above-cited Mori to thereby detect in real time the entry position on the paper form sheet **400** and recognizes the entered characters.

The entry assistance apparatus **100** thus executes the processing subroutine illustrated in FIG. **13** to thereby detect the entry position and the entered content to detect entry position and content information as entry state information. The invention may not be limited to the method of detecting an entry position and an entered content by the apparatus **100** specifically described above.

Referring again to FIG. **5**, the example of processing performed by the entry assistance apparatus **100** will further be followed. When the subroutine S**108** for detecting entry position and entered content is completed, the entry assistance apparatus **100** proceeds to step S**110**, in which, based upon the detected entry state information, the apparatus **100** decides, i.e. selects, presentation information to be presented according to the entry state. In this step, the apparatus **100** performs the estimation process (2) and the process (3) for selecting presentation information to thereby select presentation information. The apparatus **100** is responsive to the presentation information thus selected to present the content of, or indicated by, the information to be presented to the user (presentation process (4) described earlier).

Following step S**110** thus completed, the entry assistance apparatus **100** makes a decision as to whether or not the entered content is erroneous (S**112**). In the illustrative embodiment, the apparatus **100** uses stroke information obtained from the motion of the input tool **300** to perform the estimation step S**112** in order to make such a decision. Note that the invention may not be restrictive to the specific way of estimation, as described above, performed by the apparatus **100** in step S**112**.

In step S**112**, if it is determined that the entered content is not erroneous, the entry assistance apparatus **100** terminates the processing.

In step S**112**, if it is determined that the entered content is erroneous, then the entry assistance apparatus **100** selects information to be presented for error correction (S**114**), and presents the content of, or indicated by, the information to be presented to the user (presentation process (4) described earlier). The entry assistance apparatus **100** performs the processing routine illustrated in FIG. **5** to estimate the condition of the user who makes a handwritten entry, and presents the information content corresponding to the result of the estimation to the user in an appropriate method.

More specifically, the entry assistance apparatus **100** relies upon information on the position and posture of the user and information on time-serial variation in position and posture to present to the user the content of the presentation information complying with purposes, such as alert, and exemplary presentation of written items necessary for handwritten entry of characters recognized in real time. Furthermore, the apparatus **100** estimates the condition of the user according to variations in environment surrounding the apparatus **100**, such as variations in position and posture of the user, and presents to the user the content of the presentation information appropriate for the result of the estimation. That means that the apparatus **100** is not adapted to let the user control information to be presented but rather to automatically display necessary information onto intended locations, hinder information to be concealed from being presented, and appropriately switch the

method of presentation. Accordingly, the entry assistance apparatus **100** can appropriately assist the user in making handwritten entry without changing the conventional way of handwritten entry.

Thus, the entry assistance apparatus **100** can enhance the convenience of the user through the processing routine shown in FIG. **5** when the user makes a handwritten entry. The way of processing performed by the apparatus **100** may not be restricted to what is shown in and described with reference to FIG. **5**.

The entry assistance apparatus **100** in accordance with the illustrative embodiment shown in and described with reference to FIGS. **1** through **13** can thus improve the convenience of the user when making a handwritten entry. However, the present invention is not restricted to the specific configuration of the apparatus **100** in accordance with the embodiment shown in and described with reference to FIG. **2**. Now, with reference to FIG. **14**, an entry assistance apparatus, generally **200**, in accordance with an alternative embodiment will be described.

FIG. **14** is a schematic block diagram showing such an alternative configuration of the entry assistance apparatus **200**. In the alternative embodiment, a telecommunications network **500** is also included as shown in FIG. **14**. The telecommunications network **500** may be a wired network or a wireless network connected to wireless base stations. Those networks may be, for example, the Internet, or a LAN (Local Area Network) or a WAN (Wide Area Network), which use communication protocols, such as TCP/IP (Transmission Control Protocol/Internet Protocol).

Referring to FIG. **14**, the entry assistance apparatus **200** may fundamentally be similar in configuration to the entry assistance apparatus **100** except that the apparatus **200** of the alternative embodiment additionally may include a communication unit **202** and a condition learning section **204** which are interconnected as depicted, and that the apparatus **200** includes, in place of the condition estimator section **104** shown in FIG. **2**, a condition estimator section **206** which is different in function from the condition estimator section **104**. Like components may be designated with the same reference numerals, on which repetitive description will be avoided.

The entry assistance apparatus **200** is adapted to allow the condition estimator section **206** to use candidates of estimation result on user conditions, i.e. condition IDs, stored in a condition database **210** managed by the condition learning section **204** to estimate the condition of the user. The condition database **210** stores condition data including detected pieces of information, such as person condition information and/or entry state information, and candidates of estimation result on user conditions interrelatedly with each other. Each of the condition data forms a record of the condition database **210**.

The entry assistance apparatus **200** is adapted for causing the condition estimator section **206**, when having performed estimation, to transfer the results of estimation on the user condition to the condition learning section **204** so as for the latter to update the condition database **210**, i.e. register, update or delete condition data.

The entry assistance apparatus **200** can thus update the condition database **210** so as to learn the estimated condition of the user. Furthermore, the device **200** also uses candidates of estimation result on the condition of the user so as to estimate the condition of the user. The entry assistance apparatus **200** can thereby further improve the estimation accuracy than the entry assistance apparatus **100**.

The entry assistance apparatus **200** comprises the communication unit **202**, and is thus responsive to a request, when received by the communication unit **202** from an external device, so as to update the condition database. In the following description, such a request transmitted from an external device may be referred to as "update request", which may contain, exemplarily but not limitative to, control instructions for the condition database as well as status or condition data. Update requests may be ones an external device may autonomically transmit to the apparatus **200**. Alternatively, the entry assistance apparatus **200** may periodically or nonperiodically request an external device to send an update request and, in response, the external device transmits an update request to the apparatus **200**.

Depending on the attributes of the user, and/or an application or location where the entry assistance apparatus **200** is used, the apparatus **200** may need to be calibrated on estimation in advance to putting the apparatus **200** into operational use. Even in such cases, when plural entry assistance apparatus **200** are rendered operable in an enterprise or public organization, those apparatus **200** may be interconnected to the network **500**, and one of those assist apparatus **200** newly installed may receive from another entry assistance apparatus the contents of samples of obtained data including the results of estimation provided by the other entry assistance apparatus so as to learn the contents of the samples, thereby being able to reduce the cost of calibrating the apparatus **200**.

As described above, the entry assistance apparatus **200** has the learning function, and thus the accuracy in estimating the condition of the user may further be improved. The apparatus **200** has the function of communicating with an external device, e.g. another entry assistance apparatus **200**, over the network **500** and using data associated with estimate results obtained from an external device for learning, whereby the accuracy in estimating the condition of the user can further be improved. In addition, the calibration costs can further be alleviated.

Now, the configuration of the entry assistance apparatus **200** will be described in detail. The communication unit **202** is communication means included in the entry assistance apparatus **200** to communicate with an external device, such as another entry assistance apparatus **200** wirelessly or over cable directly or over the network **500**. The communication unit **202** may include a combination of a communication antenna and RF (Radio-Frequency) circuitry, or a LAN terminal, and a transmitter/receiver. The invention may not be restrictive to that specific configuration of the communication unit **202** described above. The communication unit **202** can be appropriately configured so as to be communicable with an external device over the network **500**.

The condition learning section **204** is adapted to manage the condition database **210** and may play a leading role in performing processing associated with learning the entry assistance apparatus **200** does. The learning section **204** is fabricated by, for example, an MPU or an integrated circuit for implementing various functions. The MPU or integrated circuit may also play the role of the condition estimator section **206** and/or presentation information selector **106**.

Specifically, when an inquiry is made from the condition estimator section **206**, the condition learning section **204** is responsive to detection information contained in the inquiry to search the condition database **210** and send back a response consisting of a candidate of estimation result on the user to the condition estimator section **206**. The condition learning section **204** successively transfers one or more condition identifications in the descending order of probability in expressing the condition of the user in response to the inquiry to the condition estimator section **206**.

The present invention may not be limited to the above-exemplified response to be transferred to the condition estimator section **206** by the condition learning section **204**. In an application where the condition database **210** further includes additional information, such as user attributes and/or time of day, as condition data, the condition learning section **204** may be adapted to transfer, in response to the inquiry, data with which the additional information is linked to the condition estimator section **206** in addition to condition identifications.

FIG. **15** shows in a table an example of data stored in the condition database **210** in which condition identifications indicating the conditions of the user and additional information are stored interrelatedly to each other. Examples of attribute information may include age groups, sexes, time of day and so on, which may not be restrictive. The entry assistance apparatus **200** can use attribute information complying with an application.

In addition to the condition database **210** containing condition data in which detection information and condition identifications, i.e. candidates of estimation result on the user's condition, are stored interrelatedly with each other, the entry assistance apparatus **200** may comprise a condition database in which condition identifications and additional information described above may be stored interrelatedly with each other. Databases applicable to the entry assistance apparatus **200** may not be restricted to the specific condition database containing condition data as described above in which detection information and condition identifications are interrelatedly stored and the specific condition database in which condition identifications and additional information are interrelatedly stored. The apparatus **200** can also use a condition database containing condition data in which detection information, condition identifications and additional information are stored interrelatedly with each other.

The condition learning section **204** uses the condition databases as described above to makes such a decision that those data items adopted more frequently represent the condition of the user with higher probability to transfer a response complying with the result of that decision to the condition estimator section **206**. Consequently, the entry assistance apparatus **200** can improve the efficiency in estimating the condition of the user.

When an estimation result is transferred from the condition estimator section **206** or an update request is received from an external device via the communication unit **202**, the condition learning section **204** updates the condition database, whereby the entry assistance apparatus **200** can perform more appropriate learning.

The significance that the entry assistance apparatus **200** performs learning by updating the condition databases based on an update request sent from another entry assistance apparatus **200**, i.e. external device, will now be described. For example, in a certain time of day, if there is an entry assistance apparatus **200**, called a first apparatus for convenience, which the users falling in a senior age group more often operate, it is estimated that a similar tendency may occur with another entry assistance apparatus **200** installed at the same site as the first apparatus **200**, the latter being referred to as a second apparatus. The similar tendency may be directed to a phenomenon that plural apparatus **200** of the same kind installed at one and the same site where services may be offered are highly likely to be used by the users who expect similar services in a similar time of day. Under such circumstances, when the plural entry assistance apparatus **200** can share with each other detection information and condition identifications as well as condition information with which additional information, such as user attributes and time of day, is interrelated, the estimation accuracy may further be enhanced.

FIG. **14** shows an example in which the entry assistance apparatus **200** includes the condition database **210**. The invention may not be restricted to this example. For instance, the entry assistance apparatus **200** does not include such a condition database, but alternatively the condition learning section **204** may be adapted to use a condition databases provided in an external device, e.g. server, to perform processing accordingly. In that case, a server with which plural entry assistance apparatus **200** can communicate is provided to include a condition database which may be updated based on the results of estimation provided by such plural assist apparatus **200**, thereby further improving the accuracy in each entry assistance apparatus **200** estimating.

One example of method implemented by the entry assistance apparatus **200** to acquire attribute information on the attributes of the user may include acquiring such information based on information on an entry content. More specifically, the entry assistance apparatus **200** can be designed to acquire the content of entry the user made in a name field on a paper form **400**, FIG. **1**, to obtain "user's name" as attribute information. In an application where the user makes a handwritten entry on a paper form sheet offered from a financial organization, the entry assistance apparatus **200** may be adapted for using the detected account number of the user to consult with an external device, such as a server, to acquire information on the user, such as age group, sex and kind of business, so as to deal with the acquired information of the user as his or her attribute information.

The entry assistance apparatus **200** interrelates the acquired attribute information to condition identifications, which are results of estimation on the conditions of the user, and registers the information in the condition database. For example, if a time of day is registered as additional information, the apparatus **200** performs the following processing. The apparatus **200** stores the time at or during which the apparatus **200** was used, e.g. the time at which the apparatus **200** was started in use or for which an estimation was performed, and fits the stored time to times of day categorized in advance as spaced at, for example, two-hour intervals to identify the time of day. The apparatus **200** then interrelates information on the time of day with condition identifications, and stores them in the condition database **210**. Alternatively, the apparatus **200** may interrelate the attribute information, information on the identified time of day and condition identifications with each other, and register them in the condition database **210**.

The entry assistance apparatus **200** thus can use the detection information and the additional information, such as acquired attributes of the user and time of day, to search the condition database **210** having the condition data correlatively including detection information, condition identifications and additional information stored to thereby perform estimation with the candidates of estimation result narrowed in advance down to some conditions. That makes the apparatus **200** to further improve its estimation speed. When the entry assistance apparatus **200** is newly installed prior to being placed into practice or has not yet sufficiently learned, the calibration can be simplified with the estimation accuracy enhanced.

When using a condition database including plural tables respectively prepared for different times of day, the first entry assistance apparatus **200**, referred to in the example stated above, may search a reduced amount of records with a time of day used as a condition. Specifically, the first entry assistance apparatus **200** identifies the current time of day and refers to

such a table in the condition database which is appropriate for the identified time of day. Thus, the first entry assistance apparatus **200** can reference such a smaller amount of records than a case where the whole condition database has to be searched. Accordingly, he first entry assistance apparatus **200** can search for candidates of estimation result in a reduced time, thus rendering the estimation speed improved.

In the example, it may be expected that the second entry assistance apparatus **200** is, similarly to the first entry assistance apparatus **200**, frequently used by users in a senior age group in a certain time of day. The second apparatus **200** may therefore be rendered through learning to use the same condition database as the first entry assistance apparatus **200** in order to provide estimation. Consequently, the second assist apparatus **200** can simplify the calibration, and offer the content of the information to be presented to the user with the estimation accuracy improved similarly to the first entry assistance apparatus **200**.

As described above, the entry assistance apparatus **200**, thus configured as shown in FIG. **14**, can extensively improve the accuracy in estimating the condition of the user and reduce the calibration costs. Note that the invention may not be restricted to the configuration of the entry assistance apparatus **200** shown in FIG. **14**. For example, the communication unit **202** may not be essential, i.e. the apparatus **200** may be of stand-alone configuration without including the communication unit **202**. Even with such a configuration, the entry assistance apparatus **200** can extensively improve the accuracy in estimating the condition of the user because of its learning function.

Processing performed by the present entry assistance apparatus **200** of the alternative embodiment will next be described in detail. The following description will be directed to the case the entry assistance apparatus **200** detects person condition information, entry state information and type-of-form information, as with the entry assistance apparatus **100** shown in and described with reference to FIG. **2**. Also similarly to the entry assistance apparatus **100**, the following description will be directed to the case the entry assistance apparatus **200** detects positional and postural information as person condition information and detects entry position and content information as entry state information.

Reference will now be made to FIG. **16**, a flowchart illustrating one example of processing routine performed by the entry assistance apparatus **200**. Similar steps may of course be designated with the same reference numerals. The routine shown begins, as one step period, with the state that the user was sensed and then fails to be sensed with entry estimated as ended. The figure also depicts the condition database **210**, which may be included in the entry assistance apparatus **200** as shown in FIG. **14** or provided in an external device, such as a server.

In step S**500**, the entry assistance apparatus **200** makes a decision as to whether or not it is estimated that no user becomes sensed and the entry has ended.

If, in step S**500**, it is not determined that the estimation reveals that no user is sensed and the entry has ended, then the entry assistance apparatus **200** performs the subroutine S**102** for detecting positional and postural information, as described earlier with reference to FIG. **5**.

When the subroutine S**102** for detecting positional and postural information is completed, the entry assistance apparatus **200** selects, based on the detected person condition information, presentation information to be presented according the condition of the user (S**504**). Then, the apparatus **200** presents, based on the selected presentation information, the content of, or indicated by, the presentation information to the user (presentation process (4)).

The entry assistance apparatus **200** performs the estimation process (2) and the presentation information selecting process (3) to thereby select presentation information. In the estimation process (2), the apparatus **200** refers to the condition database **210**, as depicted with a dotted line **142**, based on the person condition information, and takes account of a probability in estimating the condition of the user to thereby improve the accuracy in estimating the condition of the user, the probability being computed based on candidates of estimation result on the condition of the user. Like that, in FIG. **16**, consultations with the database **210** are depicted with dotted lines.

If step S**504** is completed, the entry assistance apparatus **200** makes a decision as to whether or not the type of paper form sheet has been identified (S**106**).

If, in step S**106**, it is not determined that the type has been identified, then the entry assistance apparatus **200** will proceed to step S**516**, which will be described later.

In step S**106**, if it is determined that the type has been identified, the entry assistance apparatus **200** performs the subroutine S**108** for detecting entry position and content information, as described with reference to FIG. **5**.

If the subroutine S**108** for detecting entry position and entered content is completed, then the entry assistance apparatus **200** selects presentation information to be presented according to the entry state, based on entry state information (S**510**). The apparatus **200** presents, based on the presentation information thus selected, the content of, or indicated by, the presentation information to the user (presentation process (4)).

The entry assistance apparatus **200** thus performs the estimation process (2) and the presentation information selecting process (3) to thereby select presentation information. Similarly to step S**504**, the apparatus **200** refers, in the estimation process (2), to the condition database **210** based on the entry state information, and takes account of a probability in estimating the condition of the user, thus improving the accuracy in estimating the condition of the user.

If step S**510** is completed, then the entry assistance apparatus **200** makes a decision as to whether or not the entered content is in error (S**112**).

In step S**112**, if it is not determined that the content is erroneous, the entry assistance apparatus **200** will then proceed to step S**516**, which will be described later.

In step S**112**, if the content is determined erroneous, then the entry assistance apparatus **200** selects information to be presented for error correction (S**514**), and presents the content of, or indicated by, the presentation information to the user (presentation process (4)). In step S**514**, the entry assistance apparatus **200** refers to the condition database **210** based on the entry state information, and takes account of a probability in estimating the condition of the user to thereby improve the accuracy in estimating the condition of the user.

If, in step S**106**, it is not determined that the type is identified, or, in step S**112**, it is not determined that the entered content is erroneous, or if step S**514** is performed, then the entry assistance apparatus **200** performs an operation for registration into the condition database **210** (S**516**). The apparatus **200** terminates the routine illustrated in FIG. **16**. If the user is sensed, then the routine shown in FIG. **16** will start again.

In step S**500**, if it is determined that no user is sensed and the entry is estimated as ended, then the entry assistance

apparatus **200** proceeds to an operation S**518** for evaluating the result of estimation, and will terminate the routine illustrated in FIG. **16**.

The entry assistance apparatus **200** of the alternative embodiment thus makes evaluation through classification in terms of, in addition to person condition and entry state, time of day, circumstances under which the apparatus **200** is installed and the attributes of the user. The apparatus **200** may be adapted to make classification by means of a statistical classification scheme, such as a k-nearest neighbor algorithm, which may not restrict the processing in step S**518**. In that case, the entry assistance apparatus **200** provides estimation by using, in steps S**102**, S**510** and S**514**, a probability that is computed by using detection information or classification results (having higher probabilities) corresponding to the detection information and additional information described earlier.

The entry assistance apparatus **200** thus performs the processing routine illustrated in FIG. **16** to thereby estimate the condition of the user who makes handwritten entry, and presents the content of the information corresponding to the estimation result to the user in a method appropriate for the estimation result. The apparatus **200** thus uses the condition database **210** for estimation in such a fashion that, if the condition of the user is estimated, the apparatus **200** updates the condition database based on the estimation result, so that the apparatus **200** learns the estimated condition of the user.

Accordingly, the entry assistance apparatus **200** yields, in addition to the advantages caused by the entry assistance apparatus **100**, advantages of further improving the estimation accuracy than the apparatus **100** shown in FIG. **2**.

The entry assistance apparatus **200** may communicate with another entry assistance apparatus **200**, acting as an example of external device, so as to obtain the results of learning from the other entry assistance apparatus **200** to thereby reflect them on its condition database **210**. Therefore, if the entry assistance apparatus **200** is not yet placed into practical use or has not learned much, the results of learning done by the other entry assistance apparatus **200** may be reflected on the condition database **210**, thus simplifying the calibration process with estimation accuracy enhanced.

The present invention may not be restricted to the specific processing routine performed by the entry assistance apparatus **200** as illustrated in FIG. **16**.

As described so far, the entry assistance apparatus **200** in accordance with the alternative embodiment is adapted for performing the processing, described earlier, starting with the detection process (1) and ending with the presentation process (4). The processing starting with the detection process (1) and ending with the presentation process (4), when executed by the entry assistance apparatus **200**, allows the apparatus **200** to estimate the condition of the user who makes a handwritten entry and present the content of information appropriate for the result of estimation to the user in a way appropriate for the result of estimation. Thus, the entry assistance apparatus **200** does not let the user control presentation information, but rather can automatically display necessary information on intended sections on the display, hinder information to be concealed from being presented, and switch the way of presentation. Accordingly, the entry assistance apparatus **200** can appropriately assist the user in making handwritten entry of characters without changing the conventional way of handwritten entry.

The entry assistance apparatus **200** can thus enhance the convenience of the user in making handwritten entry.

The present invention has been described so far with reference to the particular, illustrative embodiments of entry assistance apparatus. The invention may not be restricted to such specific embodiments. The invention can be applied to various systems and equipment permitting the user to make handwritten entry, such as utility tables, wickets, desks and so forth in financial organizations and public institutions, for example.

The entry assistance apparatus according to the present invention may be applied to a variety of uses, such as maintaining the student in studying with his or her correct posture taken in educational organizations or general households, assisting, in households, the student in examination grind in presenting solutions according to circumstances of entry, and assisting plural designers in handwrite-designing or drafting road maps in general enterprises.

The entry assistance apparatus **100** or **200** in accordance with the illustrative embodiments may, at least partially, be implemented by a processor system, or computer, which is adapted to store and execute program sequences for causing the computer to function as the apparatus, thereby improving the convenience of the user when making handwritten entry. Such program sequences may be designed for controlling the processing starting with the detection process (1) and ending with the presentation process (4) described earlier, and/or for controlling the routines illustrated in FIGS. **5** and **16**, for example.

FIG. **17** schematically shows, in a block diagram, an example of configuration of the entry assistance apparatus **100**/**200** having such program sequences stored in a storage subsystem **601** for use in controlling the computer to function as the entry assistance apparatus. In the illustrative embodiment, the storage subsystem **601** may include a hard disk drive **602** adapted for storing the programs, an optical disk drive **603** for reading a storage medium having the programs stored, and a magnetic disk drive **604**.

The storage media having programs stored thereon may be, in addition to the hard disk drive **620**, a flexible disk **606**, a magneto-optical disk, an optical disk **605** in the form of CD (Compact Disk)-ROM, CD-R (Recordable), CD-RW (Re-Writable), DVD (Digital Versatile Disk)-ROM, DVD-RAM, DVD-RW, or DVD+RW, a magnetic tape, a nonvolatile memory card, and a ROM. The programs may be downloaded to the hard disk drive **602** over a telecommunications network **500**, FIG. **14**.

While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

As described previously, the entry assistance apparatus in accordance with the illustrative embodiments is adapted to employ, as means for estimating the condition of the user, the range image sensor consisting of the laser range finder, the position sensor (positional information acquiring sensor) consisting of the pressure sensor, and infrared cameras for capturing shadow images formed on the desktop surface. The invention may not be restrictive to such specific means for estimating the condition of the user. The entry assistance apparatus may employ either of, or in combination, a solution using an array of plural cameras to acquire three-dimensional positions of a subject, a sensor array for detecting the distribution of heat sources, and a sensor array for sensing vibrations as means for estimating the condition of the user.

What I claim is:

1. An entry assistance apparatus for assisting a user in making a handwritten entry on a paper medium disposed on a surface, comprising:

a detector selection which detects, when the user makes the handwritten entry, person condition information about a condition of a body of the user, the person condition information including either or both of positional information regarding a position of the user and postural information regarding a posture of the user;

a condition estimator which estimates at least one condition of the user based on the person condition information;

a presentation information selector which selects, based on the at least one condition of the user, presentation information regarding at least one information content to be presented to the user; and

an information presenter which presents the at least one information content indicated by the presentation information to the user,

wherein said detector selection includes a center of gravity section that detects pressure values at a plurality of points within a region in which the user stands as one of entry state information on a state of the entry made by the user, the entry state information including the postural information regarding the user's position when making the entry, the detector selection additionally including at least one sensor to detect the content of the entry, the content of the entry comprising letters or characters that are recognized using at least one sensor, and

wherein said detector selection further detects type-of-form information regarding the paper medium on the surface from below the surface using infrared rays,

whereby said condition estimator uses the person condition information, the entry state information, and the type-of-form information to estimate the condition of the user.

2. The apparatus in accordance with claim **1**, wherein said condition estimator contains a plurality of conditions regarding the condition of the body of the user and the state of the entry, and

wherein said estimator uses the person condition information and the entry state information to determine whether or not each of the plurality of conditions is satisfied, and estimates the condition of the user based on a combination of results of the determination.

3. The apparatus in accordance with claim **1**,

wherein said presentation information selector has a priority set to the presentation information, and

wherein said information presenter adjusts, when said presentation information selector has selected plural pieces of presentation information, an order of presentation and/or a way of presentation based on the priority set to the selected presentation information, and presents the presentation information accordingly.

4. The apparatus in accordance with claim **1**, further comprising a condition learning section which manages a condition database containing condition data which include at least the person condition information and candidates for an estimation result regarding the condition of the user interrelatedly with each other,

wherein said condition learning section uses the person condition information and consults with said condition database to identify the candidates for the estimation result based on the condition of the user corresponding to the person condition information,

whereby said condition estimator estimates the condition of the user based on the candidates for the estimation result.

5. The apparatus in accordance with claim **4**, wherein said condition estimator transfers the estimation result on the condition of the user to said condition learning section, and causes said condition learning section to register, update or delete the condition data in said condition database.

6. The apparatus in accordance with claim **4**, further comprising a communication section communicating with an external device,

wherein said condition learning section is responsive to said communication section having received a request transmitted from the external device to register, update or delete the condition data in said condition database.

7. A method of assisting a user in making handwritten entry on a paper medium disposed on a surface when the user uses an input tool supporting handwriting entry, said method comprising the steps of:

detecting person condition information on a condition regarding a body of the user when making the entry, the person condition information including either or both of positional information about a position of the user and postural information about a posture of the user;

estimating at least one condition of the user based on the person condition information;

selecting, based on the condition of the user, presentation information regarding at least one information content to be presented to the user; and

presenting the at least one information content indicated by the presentation information to the user,

wherein said detecting step comprises using a center of gravity sensor to detect pressure values at a plurality of points within a region in which the user stands as one of entry state information on a state of the entry made by the user, the entry state information including the postural information regarding the user's position when making the entry,

wherein said detecting step additionally comprises using at least one sensor to detect the content of the entry, and

wherein said detecting step further comprises detecting type-of-form information regarding the paper medium on the surface from below the surface using infrared rays,

whereby said condition estimating step uses the person condition information, the entry state information, and the type-of-form information to estimate the condition of the user.

8. A non-transitory computer readable storage medium having a stored computer program which controls the computer, when executed on the computer, to function as an entry assistance apparatus for assisting a user in making a handwritten entry on a paper medium that is disposed on a surface with an input tool supporting handwriting entry, said program being capable of causing the computer to execute the steps of:

detecting person condition information on a condition regarding a body of the user when making the entry, the person condition information including either or both of positional information about a position of the user and postural information about a posture of the user;

estimating at least one condition of the user based on the person condition information;

selecting, based on the condition of the user, presentation information regarding at least one information content to be presented to the user; and

presenting the at least one information content indicated by the presentation information to the user,

wherein said step of detecting comprises using a center of gravity sensor to detect pressure values at a plurality of points within a region in which the user stands as one of entry state information on a state of the entry made by

the user, the entry state information including postural information regarding the user's position when making the entry,

wherein said detecting step additionally comprises using at least one sensor to detect the content of the entry, and

wherein said detecting step further comprises detecting type-of-form information regarding the paper medium on the surface from below the surface using infrared rays,

whereby said step of estimating uses the person condition information, the entry state information, and the type-of-form information to estimate the condition of the user.

9. The apparatus in accordance with claim **1**, wherein the user makes the handwritten entry on a paper medium using an input tool that leaves a mark on the paper medium.

10. The apparatus in accordance with claim **9**, wherein the input tool is a pen.

11. The method of claim **7**, wherein the handwritten entry is made on a paper medium and the input tool leaves a mark on the paper medium.

12. The storage medium of claim **8**, wherein the handwritten entry is made on a paper medium and the input tool leaves a mark on the paper medium.

13. The apparatus in accordance with claim **1**, wherein the entry state information further includes the positional information.

14. The method in accordance with claim **7**, wherein the entry state information further includes the positional information.

15. The storage medium in accordance with claim **8**, wherein the entry state information further includes the positional information.

16. An entry assistance apparatus for assisting a user in making a handwritten entry on a surface or a paper medium on the surface, the entry having a content that includes letters or characters, wherein said entry assistance apparatus comprises:

a detector section which detects, when the user makes the handwritten entry, person condition information about a condition of a body of the user, the person condition information including either or both of positional information regarding the user's position when the user makes the entry and postural information regarding the user's posture when the user making the entry;

a condition estimator which estimates at least one condition of the user based on the person condition information;

a presentation information selector which selects, based on the at least one condition of the user, presentation information regarding at least one information content to be presented to the user; and

an information presenter which presents the at least one information content indicated by the presentation information to the user,

wherein said detector section includes a center of gravity sensor that detects pressure values at a plurality of points within a region in which the user stands as one of entry state information on a state of the entry made by the user, the entry state information including the postural information regarding the user's position when making the entry, the detector section additionally including at least one sensor to detect the content of the entry,

whereby said condition estimator uses the person condition information and the entry state information to estimate the condition of the user.

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